

The Rural-Urban Projection (RUP) Program

A User's Guide

***[Revised and Updated Chapter
V of Population Analysis with
Microcomputers]***

U.S. Census Bureau

Revised July 2013 (Original: November 1994)

PREFACE
TO THE 2013 REVISED AND UPDATED CHAPTER V:
THE RURAL-URBAN PROJECTION (RUP) PROGRAM

For the first time since the publication of the two volumes of Population Analysis with Microcomputers in 1994, the U.S. Census Bureau recently has released this work online to the international community. While the techniques of demographic analysis have evolved over the past two decades, most of the techniques described in the first volume of the manual are very much in use today, just as they were in 1994. The Census Bureau's Rural-Urban Projection (RUP) program continues to offer demographers state-of-the-art projection functionality, but a new interface and complementary programs described in this revision of the second volume's Chapter V greatly increase RUP's user-friendliness, usefulness for preparing subnational projections, and adaptability to situations involving demographic events concentrated into periods of less than a year.

A number of Census Bureau staff contributed to the release of this publication online. Peter Johnson and Amin Vafa revised the description of the Census Bureau's Rural-Urban Projection program and added material on the RUPLEX interface, and on the RUPAGG and RUPCombine programs. Earlier versions of RUPAGG and RUPCombine documentation were prepared by Timothy Fowler, Thomas McDevitt, and Lisa Lollock.

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Revised and Updated Chapter V

THE RURAL-URBAN PROJECTION (RUP) PROGRAM

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A. Overview

1. This Chapter in Brief

The RUP program of the U.S. Census Bureau is designed to project either the whole population of a country, its rural and urban populations, or any area within it. This chapter describes how the program carries out the projection and provides instructions on how to use the program.

The first part introduces the RUP program, including a description of its features; a detailed examination of a sample input file; and examples of the types of output that can be obtained. The RUP Input Summary (pages 17-19) contains most of the format information needed to create an input file. Once you are familiar with the RUP program, it will be easier to refer to this RUP Input Summary than to the detailed input instructions presented in Part D.

Part B, Installation and Operation, is only partially included. It discusses some of the operational details.

Part C, or Creating a RUP Input File, is no longer needed. This discussion is contained in Addendum A, RUPEX Documentation.

Part D contains a detailed discussion of the input to RUP, including samples of different options available for some of the parameter records. You should read Section 1 (General Structure of Input to RUP, pages 22-28) to get a general orientation to the input structure, then refer to the RUP Input Summary (Part A, Section 4, pages 17-19) for format information for each parameter record. If you need more detailed information about any parameter record, refer to Sections 2 through 8.

Part E. To access files for download, see:
www.census.gov/population/international/software/uscertoolsdownload.html.

Part F outlines the program requirements for running the RUP program.

Part G presents some of the methods used by the RUP program to project the population.

Part H lists the error messages that may be generated when you run the RUP program and explains how to correct the problems.

Addendum A guides the user through the RUPEX interface. RUPEX allows the user to run RUP input files and extract output charts and tables through Microsoft Excel.

Addendum B guides the user through RUPAGG, the add-on to RUP that allows the user to aggregate multiple areas together in order to extract aggregated demographic indicators.

Addendum C guides the user through RUPCombine, the add-on to RUP that allows the user to isolate demographic shocks into one half of a year, so that the results are not spread out over an entire year (for example, isolating the deaths from a tsunami to the second half of a calendar year only).

2. Features

The most commonly used method for projecting populations is the cohort component method, which projects each age and sex cohort over time based on the components of growth. Annual births create new cohorts, while existing cohorts are decreased by mortality and either increased or decreased by migration.

The RUP program has features that allow a considerable amount of flexibility for specifying projected trends in fertility, mortality, and migration. It also includes a wealth of output options that allow a detailed examination of the results. These features are described below.

- (1) The projection is performed by single years of age. This feature allows you to obtain data for special age groups that do not fall into conventional 5-year age groups. It also allows you to track population cohorts that may be smaller or larger than surrounding cohorts due to past demographic events.
- (2) The projection is performed year by year. This feature allows you to input information on demographic events for a particular year (e.g., excess mortality due to an earthquake) without spreading the effect over a 5-year period. It also provides planners with estimates for each year without having to interpolate between data for surrounding years.
- (3) Input data for the population and components can be provided in either single ages or 5-year age groups. The age groupings of each item are independent, so you can input 5-year data for some items and single-year data for others. The program converts all data to single years of age before performing the projection (see part G, pages 69-82, for details).
- (4) The open-ended age group in your input data can vary between 50 years and over and 100 years and over. In spite of doubts regarding the accuracy of data for the population at the oldest ages, projections should be made using the highest possible open-ended age group to more accurately represent the population dynamics. If you desire, you can still aggregate your results with a younger open-ended age group.
- (5) The program accepts mortality and fertility rates as input (as do most programs), and it also allows the input of numbers of births, deaths, and/or migrants. This feature allows you to update a base population with recent actual data on vital events. For instance, if your country has census data for 1982 and registered deaths and births as well as migrants from 1982 to 1989, you can include these actual data in the projection without having to estimate rates. In this case, the program would project the 1982 population by age and sex using life tables consistent with the numbers of deaths (by age and/or sex if available) and mortality patterns for surrounding years, ASFRs consistent with the numbers of births (by age of mother if available), and the known number of migrants for the years 1982 to 1989. For subsequent years, the program would use the projected trend of these components as specified in the input.

- (6) You can provide input data for any year, including years prior to or following the projection period. The choices for each component (mortality, fertility, international migration, and internal migration) are completely independent. For example, a projection starting in 1970 can have fertility inputs for 1970, 1977, and 1995 and mortality inputs for 1965, 1975, and 2000. Data inputs for years outside the projection period are used to interpolate estimates for years during the projection and/or as patterns of the age structure of the particular component.
- (7) The program provides output of a wide variety of demographic measures for any specified year of the projection. These outputs include:
 - (a) Population by sex and age (single years, 5-year age groups, special groups) and summary measures of age (e.g., percentages, sex ratios, median ages, dependency ratios).
 - (b) Summary vital rates (e.g., crude rates, life expectancy, infant mortality rates, and total fertility rates).
 - (c) Life tables.
 - (d) Net numbers of migrants or migration rates by age and sex.
 - (e) Number of deaths, by age and sex.
 - (f) Number of births, by age of mother, and age-specific fertility rates.
- (8) You can make the projection for one or two areas. If two areas are projected, the program can calculate a third area as the sum of the two areas (e.g., total = rural + urban) or the difference (e.g., urban = total - rural).

The flexibility described above has the clear advantage of allowing a demographer to create a projection model that accurately reflects what is known about the demographic situation in a country and making maximum use of available data in as close as possible to its original form. However, this flexibility comes at a price as it places a burden on you as the user (1) to decide on the best way to model the situation (since the program does not limit the options) and (2) to provide accurate data for all the inputs required to run the program.

3. Sample Input and Output

This section presents a sample input file to show you some of the capabilities of the program. It illustrates the simplicity of the input file and shows the wide variety of outputs available.

3.1 Sample Input

Page 5 presents an example of a RUP input file. It is the RUPTSTA.IN file that is included on the RUP distribution disk. The input file consists of records or lines of input. We will describe the function of each record (line) in the file.

There are three types of records:

- (1) Parameter records specify the different options and types of data needed to run the program. These records start with a record type of 1 to 4 characters and are generally defined by those characters (see Table 1, pages 23-24).
- (2) Data records are just data (numbers), such as the population by age and sex or age-sex-specific central death rates or text (see Section 1.2, page 28).
- (3) Comment records are input lines that begin with an asterisk (*) in the first column. These records do not affect the projection but allow the user to document the sources of input data or assumptions, separate sections of input, etc.

The first record (line 1) is a TITL record, which indicates that title records will follow. In this case, the "1" in column 20 indicates that there is only one title record. Line 2 is the title record itself, so that the text "RUPTSTA--TOTAL COUNTRY ONLY" will appear on each page of output.

Line 3 is the N5 record, which indicates that the default age grouping of input data is 5-year age groups. The 17 in columns 19-20 indicates that the projection should be performed with 17 5-year age groups, from 0-4 to 80 years and over.

Line 4 is the PROJ record, which indicates how far the population should be projected. In this case the "1990" in columns 7-10 means the projection should end in 1990.

Line 5 is the SXRB record, which gives the sex ratio at birth. In this example, the value "1.02" in columns 17-20 indicates that in this projection there will be 1.02 male births for every female birth.

Sample input file: RUPTSTA.IN

```

Line *          10          20          30          40          50          60          70          80
-----|-----|-----|-----|-----|-----|-----|-----|
1.  TITL                      1
2.  RUPTSTA--TOTAL COUNTRY ONLY
3.  N5                      17
4.  PROJ  1990
5.  SXRB                      1.02
6.  REG                      1
7.  TOT
8.  * COMMENT LINES CAN BE USED TO DOCUMENT THE SOURCES OF INPUT DATA
9.  POP M51985                156218.
10.    722278    601552    531057    613793    703468    654624    531398    416520
11.    328363    270353    213639    166875    121324    80000    40000    20000
12.    10000
13.  POP F51985                155191.
14.    718820    599948    525649    476192    456479    413302    343960    278834
15.    225361    187277    146269    107610    73955    100000    50000    25000
16.    12500
17.  *****
18.  * FIRST LIFE TABLE PRE-DATES BASE YEAR OF PROJECTION
19.  MX M51980
20.    .09828    .00845    .00157    .00124    .00273    .00463    .00716    .00943
21.    .01237    .01548    .02073    .02513    .03339    .03982    .05000    .06000
22.    .07000    .08000
23.  MX F51980
24.    .09359    .00836    .00138    .00105    .00180    .00264    .00372    .00499
25.    .00665    .00829    .01118    .01347    .01940    .02478    .03000    .04000
26.    .05000    .06000
27.  MXM M51985                62.06
28.  MXM F51985                67.61
29.  MXM M51990                64.00
30.  MXM F51990                70.00
31.  * ULTIMATE LIFE TABLE
32.  MX M52100                .12    1.30
33.    .004702    .000286    .0000672    .0002887    .0005264    .0007616    .0006788    .0007806
34.    .0011155    .0016384    .0027132    .0042289    .0063520    .0098638    .0156264    .0253448
35.    .0423668    .0913791
36.  MX F52100                .12    1.30
37.    .003934    .000296    .0000862    .0001298    .0001810    .0002428    .0003019    .0004275
38.    .0006692    .0010214    .0016147    .0024752    .0036087    .0056070    .0091217    .0156613
39.    .0287332    .0685220
40.  *****
41.  ASFR 51985
42.    0.090    0.240    0.280    0.224    0.140    0.100    0.045
43.  TFR  1985    3.940
44.  ASFR 52010
45.    0.090    0.240    0.240    0.180    0.103    0.066    0.028
46.  TFR  2010    2.955
47.  *****
48.  * MIGRATION GIVEN FOR ONE YEAR WILL BE HELD CONSTANT FOR THE WHOLE PROJECTION
49.  MIGNM51987
50.    -21983    -21983    -19567    11830    25799    -2334    -8310    -7885
51.    -7786    -6503    -4774    -3349    -2810    -800    -400    -200
52.    -100
53.  MIGNF51987
54.    -21986    -21986    -20547    -14805    -5556    -7095    -6746    -4571
55.    -4293    -3749    -3639    -4101    -4104    -1000    -500    -250
56.    -125
57.  *****
58.  * FULL-PAGE OUTPUT, AND LIFE TABLES FOR 1985 AND 1990 ONLY
59.  OUTP 1985                5    1990
60.  OMX  1985                5    1990
61.  END

```

Line	*	10	20	30	40	50	60	70	80
6.	REG		1						
7.	TOT								
8.	* COMMENT LINES CAN BE USED TO DOCUMENT THE SOURCES OF INPUT DATA								

Line 6 is the REG record, which tells the program which Coale-Demeny model life table region to use. This information is used for estimating life tables, patterns of change in life tables, and separation factors. In this case, the value "1" in column 20 indicates the Coale-Demeny west model region will be used.

Line 7 is the TOT record, which tells the program that the projection is for the total country (or other unit).

Line 8 contains a comment, since it starts with an asterisk (*) in column 1. One or more comment lines in this location normally would be used to document the source of the input population data.

Line	*	10	20	30	40	50	60	70	80
9.	POP M51985			156218.					
10.		722278	601552	531057	613793	703468	654624	531398	416520
11.		328363	270353	213639	166875	121324	80000	40000	20000
12.		10000							
13.	POP F51985			155191.					
14.		718820	599948	525649	476192	456479	413302	343960	278834
15.		225361	187277	146269	107610	73955	100000	50000	25000
16.		12500							

Line 9 contains a POP record, which indicates population input. On this first POP record the "M" in column 5 indicates data for males, and the "5" in column 6 indicates data in 5-year age groups. The year "1985" in columns 7-10 tells the program that the following data are for the year 1985. This year is therefore the base year of the projection. The figure "156218." in columns 24-30 is the male population under age 1. This figure is used to improve the splitting of the population in 5-year age groups into single years of age.

Lines 10-12 contain the male population in 5-year age groups: starting with the figure "722278" on line 10 for the population ages 0-4 and ending with the figure "10000" on line 12 for the population ages 80 years and over. Lines 13-16 contain the corresponding population data for females.

Line *	10	20	30	40	50	60	70	80
17.	*****							
18.	* FIRST LIFE TABLE PRE-DATES BASE YEAR OF PROJECTION							
19.	MX	M51980						
20.		.09828	.00845	.00157	.00124	.00273	.00463	.00716
21.		.01237	.01548	.02073	.02513	.03339	.03982	.05000
22.		.07000	.08000					.06000
23.	MX	F51980						
24.		.09359	.00836	.00138	.00105	.00180	.00264	.00372
25.		.00665	.00829	.01118	.01347	.01940	.02478	.03000
26.		.05000	.06000					.04000

Line 17 is another comment line. In this case it serves to separate the population data from the mortality data that follow. A similar purpose is served by the comment records in lines 40, 47, and 57, while lines 18, 48, and 58 contain comments about the data.

Line 19 is an MX record, which signals input of age-sex-specific central death rates. As with the POP record, this record contains indicators as to the sex (male), age grouping (5-year age groups), and year (1980). As the comment on line 18 notes, these death rates pertain to a year prior to the base year of the projection. In this case, these rates for 1980 will be used to determine life tables for 1985 and 1990 (see lines 27-30). One difference between the MX input data and the POP input data is that the MX input data by 5-year age groups are always input as ages under 1, ages 1-4, then 5-year age groups. On the MX record, the age code of "5" means the same as an age format code of "4." Lines 20-22 contain the input central death rates by age for males. Lines 23-26 contain the MX record and corresponding data for females.

Line *	10	20	30	40	50	60	70	80
27.	MXM M 1985	62.06						
28.	MXM F 1985	67.61						
29.	MXM M 1990	64.00						
30.	MXM F 1990	70.00						
31.	* ULTIMATE LIFE TABLE							
32.	MX M 2100	.12	1.30					
33.		.004702	.000286	.0000672	.0002887	.0005264	.0007616	.0006788
34.		.0011155	.0016384	.0027132	.0042289	.0063520	.0098638	.0156264
35.		.0423668	.0913791					.0253448
36.	MX F 2100	.12	1.30					
37.		.003934	.000296	.0000862	.0001298	.0001810	.0002428	.0003019
38.		.0006692	.0010214	.0016147	.0024752	.0036087	.0056070	.0091217
39.		.0287332	.0685220					.0156613
40.	*****							

Line 27 is an MXM record, which indicates the user wishes to have a life table generated with a given life expectancy at birth. In this case, a life expectancy of 62.06 for males in 1985 is specified. Line 28 contains the corresponding life expectancy for females in 1985, and lines 29 and 30 contain life expectancy data for 1990. Since life tables are being provided for an earlier (1980) and later (2100) year than designated in these MXM records, the life tables for the years specified (1985 and 1990) will be estimated by linearly interpolating between the logarithms of the ${}_n m_x$ values from the surrounding life tables in order to obtain the desired life expectancy.

Line *	10	20	30	40	50	60	70	80
41.	ASFR 51985							
42.	0.090	0.240	0.280	0.224	0.140	0.100	0.045	
43.	TFR 1985	3.940						
44.	ASFR 52010							
45.	0.090	0.240	0.240	0.180	0.103	0.066	0.028	
46.	TFR 2010	2.955						
47.	*****							

Line 41 is an ASFR record, which informs the program that age-specific fertility rates are being entered. In this case, the data are for 1985 and are in 5-year age groups. By default, the first age group of fertility data is assumed to be 15-19, but the age group 10-14 can be specified if desired (see page 51). Line 42 contains the ASFRs for 1985.

Line 43 contains a TFR record, which inputs a desired level of the total fertility rate (TFR). In this case, since it is also for the year 1985, it will be used to adjust the fertility rates specified in line 42 to obtain the TFR of 3.940 specified in columns 16-20 of line 43. In other situations, the TFR record will cause the program to adjust ASFRs for another year or to interpolate between sets of ASFRs. Lines 44-46 contain the same sequence of records for the year 2010. Since no estimates are given for the projection years 1986-1990, ASFRs for these years will be estimated by linear interpolation between the inputs for 1985 and 2010.

Line *	10	20	30	40	50	60	70	80
48.	* MIGRATION GIVEN FOR ONE YEAR WILL BE HELD CONSTANT FOR THE WHOLE PROJECTION							
49.	MIGNM51987							
50.	-21983	-21983	-19567	11830	25799	-2334	-8310	-7885
51.	-7786	-6503	-4774	-3349	-2810	-800	-400	-200
52.	-100							
53.	MIGNF51987							
54.	-21986	-21986	-20547	-14805	-5556	-7095	-6746	-4571
55.	-4293	-3749	-3639	-4101	-4104	-1000	-500	-250
56.	-125							
57.	*****							

Line 48 contains a comment about the migration data.

Line 49 contains a MIGN record, which indicates the input of net numbers of international migrants. As the note in line 48 indicates, when only one input for a component exists, it will be held constant throughout the projection. This means that the year specified on the MIGN record has no impact on the results of the projection, specifying the year as 1892 or 2133 would obtain the same results. However, it is useful to put a meaningful date on the parameter record, either the base year or the year for which it is an actual estimate. The data in this example are negative, representing net out-migration, for all groups except men ages 15-24.

Line *	10	20	30	40	50	60	70	80
----	-----	-----	-----	-----	-----	-----	-----	-----

```

58.  * FULL-PAGE OUTPUT, AND LIFE TABLES FOR 1985 AND 1990 ONLY
59.  OUTF 1985      5      1990
60.  OMX  1985      5      1990
61.  END

```

Line 58 contains a comment about the output options selected in lines 59 and 60. Line 59 is an OUTP record, instructing the program to produce detailed output. The "1985" in columns 7-10 indicates that this output should start in 1985, the "5" in column 20 indicates the output should be produced every 5 years, and the "1990" in columns 27-30 tells the program to stop printing this output after 1990. Since this projection starts in 1985 and ends in 1990, this record would result in output only for the years 1985 and 1990. This output record would produce output on population, vital rates, and migration (see parts 3.2.2, 3.2.3, and 3.2.4, pages 11-13).

Line 60 contains an OMX record, which instructs the program to produce output of age-specific central death rates ($n\text{m}_x$ values). In this case, the output will be life tables by sex, for the years 1985 and 1990. Sample life table output is presented in part 3.2.5, page 14.

Line 61 is an END record, which signals the end of the projection inputs.

3.2 Sample Output

3.2.1 Summary Tables 1 and 2

RUP always produces Summary Tables 1 and 2 for all years of the projection. These tables allow the user to check that assumptions about fertility and mortality were properly implemented and that the other measures are within expected limits.

S U M M A R Y T A B L E 1 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

YEAR	MIDYEAR POPULATION	EXPON. GROWTH RATE (%)	GROWTH RATE (%)	C A L E N D A R Y E A R				D A T A ----- NET INTERNATIONAL	
				BIRTHS	CBR	DEATHS	CDR	MIGRANTS	RATE
1985	10,766,400		.114	292,373	27.16	84,016	7.80	-196,076	-18.21
1986	10,779,326	.120	.126	291,159	27.01	81,445	7.56	-196,142	-18.20
1987	10,792,325	.121	.115	289,359	26.81	80,723	7.48	-196,208	-18.18
1988	10,803,881	.107	.099	287,018	26.57	80,126	7.42	-196,208	-18.16
1989	10,813,449	.089	.078	284,200	26.28	79,538	7.36	-196,208	-18.14
1990	10,820,583	.066	.054	280,970	25.97	78,949	7.30	-196,208	-18.13

S U M M A R Y T A B L E 2 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

YEAR	-EXPECTATION OF LIFE AT BIRTH- --BOTH--			-INFANT MORTALITY RATE (PER 1,000)- ----BOTH---			TFR(5)	TFR(1)
	--SEXES--	--MALE--	-FEMALE--	---SEXES--	--MALE--	---FEMALE---		
1985	64.81	62.06	67.61	56.7	50.6	62.8	3.9400	3.9400
1986	65.23	62.44	68.08	54.9	49.2	60.8	3.9006	3.9006
1987	65.66	62.82	68.55	53.1	47.7	58.7	3.8612	3.8612
1988	66.09	63.21	69.03	51.4	46.3	56.6	3.8218	3.8218
1989	66.53	63.60	69.51	49.6	44.8	54.4	3.7824	3.7824
1990	66.97	64.00	70.00	47.8	43.4	52.3	3.7430	3.7430

3.2.2 Population Output

The population output (part of the detailed output produced when the OUTP record is included) gives a comprehensive overview of the population by age and sex. Further detail (in the form of population data by single years of age) can be obtained by including an 'OPOP 1' record in the input (see Section 3.2.6, page 15 for sample single-year population output).

DATA FOR THE YEAR 1985 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

POPULATION BY AGE AND SEX, AND SELECTED DERIVED MEASURES

-----MIDYEAR POPULATION-----				----PERCENT DISTRIBUTION----			SEX	
AGE	BOTH SEXES	MALE	FEMALE	BOTH SEXES	MALE	FEMALE	RATIO	AGE
ALL AGES	10,766,400	6,025,244	4,741,156	100.0	100.0	100.0	127.1	ALL AGES
0- 4	1,441,098	722,278	718,820	13.4	12.0	15.2	100.5	0- 4
5- 9	1,201,500	601,552	599,948	11.2	10.0	12.7	100.3	5- 9
10-14	1,056,706	531,057	525,649	9.8	8.8	11.1	101.0	10-14
15-19	1,089,985	613,793	476,192	10.1	10.2	10.0	128.9	15-19
20-24	1,159,947	703,468	456,479	10.8	11.7	9.6	154.1	20-24
25-29	1,067,926	654,624	413,302	9.9	10.9	8.7	158.4	25-29
30-34	875,358	531,398	343,960	8.1	8.8	7.3	154.5	30-34
35-39	695,354	416,520	278,834	6.5	6.9	5.9	149.4	35-39
40-44	553,724	328,363	225,361	5.1	5.4	4.8	145.7	40-44
45-49	457,630	270,353	187,277	4.3	4.5	4.0	144.4	45-49
50-54	359,908	213,639	146,269	3.3	3.5	3.1	146.1	50-54
55-59	274,485	166,875	107,610	2.5	2.8	2.3	155.1	55-59
60-64	195,279	121,324	73,955	1.8	2.0	1.6	164.1	60-64
65-69	180,000	80,000	100,000	1.7	1.3	2.1	80.0	65-69
70-74	90,000	40,000	50,000	.8	.7	1.1	80.0	70-74
75-79	45,000	20,000	25,000	.4	.3	.5	80.0	75-79
80+	22,500	10,000	12,500	.2	.2	.3	80.0	80+
SPECIAL AGE GROUPS								
0	311,409	156,218	155,191	2.9	2.6	3.3	100.7	0
1- 4	1,129,689	566,060	563,629	10.5	9.4	11.9	100.4	1- 4
0-14	3,699,304	1,854,887	1,844,417	34.4	30.8	38.9	100.6	0-14
15-24	2,249,932	1,317,261	932,671	20.9	21.9	19.7	141.2	15-24
15-44	5,442,294	3,248,166	2,194,128	50.5	53.9	46.3	148.0	15-44
15-49	5,899,924	3,518,519	2,381,405	54.8	58.4	50.2	147.7	15-49
15-64	6,729,596	4,020,357	2,709,239	62.5	66.7	57.1	148.4	15-64
50-64	829,672	501,838	327,834	7.7	8.3	6.9	153.1	50-64
55+	807,264	438,199	369,065	7.5	7.3	7.8	118.7	55+
65+	337,500	150,000	187,500	3.1	2.5	4.0	80.0	65+
75+	67,500	30,000	37,500	.6	.5	.8	80.0	75+
MEDIAN AGE	22.6	23.9	20.5					
DEPENDENCY RATIOS: 100X(DEPENDENT AGES) / (AGES 15-64)								
(0-14) + (65+)	60.0	49.9	75.0					
(0-14)	55.0	46.1	68.1					
(65+)	5.0	3.7	6.9					

3.2.3 Vital Rates Output

The detailed vital rates output is produced as part of the detailed output when the OUTP record (page 66) is included in the input). This output provides additional information not found in Summary Tables 1 and 2, in particular, presenting the components of growth, by sex, and fertility data, by age of mother.

DATA FOR THE YEAR 1985 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

VITAL RATE SUMMARY
(RATES PER 1,000 POPULATION, EXCEPT WHERE NOTED)

ITEM	RATE
CBR	27.16
CDR	7.80
RNI (%)	1.935
NET MIGRATION RATE	-18.21
GROWTH RATE (%)	.114

COMPONENTS OF POPULATION GROWTH BY SEX

	BOTH SEXES	MALE	FEMALE
BIRTHS	292,373	147,634	144,739
DEATHS	84,016	49,512	34,504
NATURAL INCREASE	208,357	98,122	110,235
NET MIGRANTS	-196,076	-71,107	-124,969
POPULATION CHANGE	12,281	27,015	-14,734

FERTILITY MEASURES

AGE	ASFR	BIRTHS
15-19	63.4	30,180
20-24	169.0	77,149
25-29	197.2	81,493
30-34	157.7	54,257
35-39	98.6	27,489
40-44	70.4	15,870
45-49	31.7	5,935

TFR 3.9400

MORTALITY MEASURES

ITEM	BOTH SEXES	MALE	FEMALE
EXPECTATION OF LIFE AT BIRTH	64.81	62.06	67.61
INFANT MORTALITY RATE	56.67	50.61	62.85
INFANT DEATHS	18,418	8,211	10,207

3.2.4 Migration Output

The detailed migration output is produced as part of the detailed output when the input includes an OUTP record (see page 66) and international or internal migration data. This output presents data on net numbers of migrants and net migration rates, by age and sex. For subarea projections with internal migration (RUMN or RUMR records), a panel is produced showing net internal migration by age and sex.

DATA FOR THE YEAR 1985 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

NET MIGRATION MEASURES BY AGE AND SEX
(RATES PER 1,000 POPULATION)

-----NET NUMBER OF MIGRANTS-----				-----NET MIGRATION RATE-----			
AGE	BOTH SEXES	MALE	FEMALE	BOTH SEXES	MALE	FEMALE	AGE
NET INTERNATIONAL MIGRATION							
ALL AGES	-196,076	-71,107	-124,969	-18.2	-11.8	-26.4	ALL AGES
0- 4	-43,939	-21,968	-21,971	-30.5	-30.4	-30.6	0- 4
5- 9	-43,941	-21,969	-21,972	-36.6	-36.5	-36.6	5- 9
10-14	-40,086	-19,553	-20,533	-37.9	-36.8	-39.1	10-14
15-19	-2,973	11,822	-14,795	-2.7	19.3	-31.1	15-19
20-24	20,229	25,781	-5,552	17.4	36.6	-12.2	20-24
25-29	-9,422	-2,332	-7,090	-8.8	-3.6	-17.2	25-29
30-34	-15,047	-8,305	-6,742	-17.2	-15.6	-19.6	30-34
35-39	-12,447	-7,879	-4,568	-17.9	-18.9	-16.4	35-39
40-44	-12,071	-7,781	-4,290	-21.8	-23.7	-19.0	40-44
45-49	-10,245	-6,499	-3,746	-22.4	-24.0	-20.0	45-49
50-54	-8,407	-4,770	-3,637	-23.4	-22.3	-24.9	50-54
55-59	-7,445	-3,347	-4,098	-27.1	-20.1	-38.1	55-59
60-64	-6,909	-2,808	-4,101	-35.4	-23.1	-55.5	60-64
65-69	-1,800	-800	-1,000	-10.0	-10.0	-10.0	65-69
70-74	-899	-400	-499	-10.0	-10.0	-10.0	70-74
75-79	-449	-199	-250	-10.0	-10.0	-10.0	75-79
80+	-225	-100	-125	-10.0	-10.0	-10.0	80+

3.2.5 Life Table Output

Life table output is produced when an OMX record (see page 66) is included in the input. The life table output allows the user to check on how the program is estimating mortality by age and to examine changes in age-specific mortality measures over time.

DATA FOR THE YEAR 1985 : T O T A L

10/31/1990 16:20

RUPTSTA--TOTAL COUNTRY ONLY

ABRIDGED LIFE TABLE FOR MALE

AGE	Q(X)	D(X)	M(X)	1(X)	L(X)	S(X)	T(X)	E(X)
0	.05061	5061.	.05256	100000.	96298.	.96298	6206009.	62.06
1	.01653	1569.	.00418	94939.	375601.	.94380	6109711.	64.35
5	.00409	382.	.00082	93370.	465892.	.98727	5734110.	61.41
10	.00458	426.	.00092	92987.	463871.	.99566	5268219.	56.66
15	.00968	896.	.00195	92561.	460566.	.99288	4804348.	51.90
20	.01584	1452.	.00319	91665.	454696.	.98726	4343782.	47.39
25	.02180	1967.	.00441	90213.	446150.	.98120	3889085.	43.11
30	.02784	2456.	.00565	88247.	435093.	.97522	3442935.	39.01
35	.03699	3173.	.00754	85790.	421018.	.96765	3007842.	35.06
40	.04758	3931.	.00975	82617.	403257.	.95781	2586823.	31.31
45	.06594	5189.	.01364	78686.	380457.	.94346	2183566.	27.75
50	.08343	6132.	.01741	73497.	352156.	.92561	1803110.	24.53
55	.11199	7544.	.02373	67365.	317967.	.90292	1450954.	21.54
60	.13900	8315.	.02988	59821.	278319.	.87531	1132987.	18.94
65	.17914	9227.	.03935	51506.	234465.	.84243	854668.	16.59
70	.22319	9436.	.05024	42280.	187808.	.80100	620203.	14.67
75	.27260	8953.	.06312	32843.	141834.	.75521	432395.	13.17
80	1.00000	23890.	.08222	23890.	290561.	.67198	290561.	12.16

$S(0) = L(0) / 1(0)$

$S(1) = 5L(5) / 5*1(0)$

$S(X) = 5L(X) / 5L(X-5)$

$S(80) = L(80) / T(75)$

SINGLE YEAR LIFE TABLE VALUES FOR AGES UNDER 5 YEARS

AGE	Q(X)	D(X)	M(X)	1(X)	L(X)	S(X)	T(X)	E(X)
0	.05061	5061.	.05256	100000.	96298.	.96298	6206009.	62.06
1	.00836	794.	.00839	94939.	94542.	.98177	6109711.	64.35
2	.00391	368.	.00391	94145.	93961.	.99386	6015169.	63.89
3	.00271	254.	.00271	93778.	93650.	.99669	5921207.	63.14
4	.00165	154.	.00165	93523.	93446.	.99782	5827557.	62.31

$S(0) = L(0) / 1(0)$

$S(X) = L(X) / L(X-1)$

SEPARATION FACTOR FOR AGE 0= .2685

SEPARATION FACTOR FOR AGES 1-4= 1.3524

3.2.6 Single Year Population Output

Single year population output is produced by including an OPOP record (see page 66) specifying an age grouping of 1 (single years). For example, the following input would generate this table:

OPOP 1 1990

DATA FOR THE YEAR 1990 : T O T A L

12/04/1990 08:47

RUPA--TOTAL COUNTRY ONLY TEST ALL OUTPUTS

AGE	--M I D Y E A R P O P U L A T I O N--			AGE	--M I D Y E A R P O P U L A T I O N--		
	-BOTH SEXES-	----MALE----	---FEMALE---		-BOTH SEXES-	----MALE----	---FEMALE---
ALL AGES	10820583.	6153098.	4667485.				
0	268,277	135,886	132,391	40	135,574	80,844	54,730
1	257,319	130,754	126,565	41	128,525	76,317	52,208
2	248,843	126,684	122,159	42	121,823	72,042	49,781
3	240,602	122,678	117,924	43	115,542	68,068	47,474
4	231,330	118,208	113,122	44	109,653	64,376	45,277
5	257,238	129,872	127,366	45	104,048	60,903	43,145
6	251,308	126,534	124,774	46	98,796	57,687	41,109
7	241,055	120,924	120,131	47	94,124	54,836	39,288
8	230,719	115,656	115,063	48	90,120	52,409	37,711
9	220,953	110,837	110,116	49	86,621	50,300	36,321
10	212,140	106,570	105,570	50	83,497	48,481	35,016
11	204,174	102,715	101,459	51	80,449	46,777	33,672
12	196,859	99,034	97,825	52	77,218	44,978	32,240
13	190,047	95,413	94,634	53	73,635	42,980	30,655
14	183,467	91,701	91,766	54	69,826	40,864	28,962
15	180,538	90,858	89,680	55	65,910	38,714	27,196
16	182,204	93,979	88,225	56	62,070	36,661	25,409
17	186,104	99,210	86,894	57	58,399	34,743	23,656
18	192,736	107,126	85,610	58	54,945	33,003	21,942
19	201,489	117,065	84,424	59	51,671	31,397	20,274
20	209,519	125,856	83,663	60	48,628	29,806	18,822
21	216,276	132,760	83,516	61	45,649	28,163	17,486
22	223,761	139,926	83,835	62	42,503	26,515	15,988
23	231,856	147,122	84,734	63	39,067	24,821	14,246
24	240,146	154,122	86,024	64	35,542	23,110	12,432
25	243,483	157,075	86,408	65	32,253	21,550	10,703
26	240,917	155,343	85,574	66	29,768	20,174	9,594
27	236,311	151,883	84,428	67	28,416	18,857	9,559
28	228,902	146,113	82,789	68	28,560	17,607	10,953
29	219,255	138,501	80,754	69	29,678	16,408	13,270
30	211,193	132,371	78,822	70	30,961	15,158	15,803
31	205,245	128,204	77,041	71	31,357	13,804	17,553
32	198,191	123,281	74,910	72	30,470	12,414	18,056
33	190,061	117,679	72,382	73	27,769	10,955	16,814
34	181,121	111,563	69,558	74	23,838	9,481	14,357
35	172,346	105,583	66,763	75	19,559	8,056	11,503
36	164,197	100,038	64,159	76	15,702	6,752	8,950
37	156,351	94,711	61,640	77	12,755	5,631	7,124
38	149,123	89,832	59,291	78	10,798	4,710	6,088
39	142,409	85,325	57,084	79	9,594	3,968	5,626
				80+	47,205	19,786	27,419

3.2.7 Output of Deaths by Age

The output of deaths by age is produced by including the ODTH record in the input file (see page 66). This output is useful for comparing the results with registered data, if available, or, in general, to examine the distribution of deaths by age.

DATA FOR THE YEAR 1985 : T O T A L

12/04/1990 08:47

RUPA--TOTAL COUNTRY ONLY TEST ALL OUTPUTS

DEATHS BY AGE AND SEX

AGE	BOTH SEXES	MALE	FEMALE
ALL AGES	84,016	49,512	34,504
0	18,418	8,211	10,207
1	2,979	1,262	1,717
2	1,324	563	761
3	865	376	489
4	561	219	342
5- 9	1,102	494	608
10-14	926	488	438
15-19	1,858	1,194	664
20-24	3,170	2,246	924
25-29	4,047	2,885	1,162
30-34	4,306	3,000	1,306
35-39	4,576	3,140	1,436
40-44	4,681	3,201	1,480
45-49	5,375	3,687	1,688
50-54	5,351	3,720	1,631
55-59	5,691	3,959	1,732
60-64	5,178	3,625	1,553
65-69	5,776	3,148	2,628
70-74	3,811	2,010	1,801
75-79	2,438	1,262	1,176
80+	1,583	822	761

4. RUP Input Summary

```

*-----:-----
* 56 10      20      30      40      50      60      70      80: Description
*-----:-----
EDIT                                     : Scan inputs, do not
*-----:-----: project.
TITL      ntitl                         : Title for labeling output.
title lines                             :
*-----:-----:
N5          nage5                       : # of 5-year age groups.
N          nage1                       : # of single ages.
*-----:-----:
PROJ yend                               : Final year of projection.
*-----:-----:
SXRB year      Sxrb                     : Sex ratio at birth.
*-----:-----:
SPAG          nspag                     : Special age groups.
L1  U1  L2  U2  L3  U3  L4  U4  L5  U5  L6  U6  L7  U7
*-----:-----:
REG          region                     : Coale-Demeny region
*-----:-----:
AREA                                     : Area name (e.g., URBAN).
area name                             :
*-----:-----:
CODE          arnum                     : Code for current area.
*-----:-----:
TOT                                     : Total projection.
*-----:-----:
POP sayear      na      p0      tpop      : Base population data.
pop 1      pop 2      pop 3      pop 4      pop 5      etc.
*-----:-----:
MX sayear      sep0      sep1      na      adj      : Input age-specific central
mx 1      mx 2      mx 3      mx 4      mx 5      etc.      : death rates.
QX sayear      sep0      sep1      na      : Input age-specific
qx 1      qx 2      qx 3      qx 4      qx 5      etc.      : probabilities of dying.
*-----:-----:
MLT sayear      e0                                     : Model life table.
MXM s year      e0      sep0                           : Modify mx values to get
*-----:-----: desired e0.
* note that the SEP0 record, if desired, must follow the DTH record      : Input deaths by age and
DTH s year      na      bsdth      mdth      fdth      : sex.
SEP0          sep0m      sep0f                             : Separation factors, age 0.
age wid      maled      femd
or
age wid      bsexd
*-----:-----:
*      10      20      30      40      50      60      70      80:
*-----:-----

```

4. RUP Input Summary (continued)

```

*-----:-----
* 56 10      20      30      40      50      60      70      80: Description
*-----:-----
ASFR ayear      ia      : Input age-specific
  asfr 1      asfr 2      asfr 3      asfr 4      asfr 5      etc.      : fertility rates.
*-----:-----
TFR  year      tfr      : Input total fertility rate.
*-----:-----
BTH  year      na      bsbth      mbth      fbth      : Input births by age.
  age wid      bsexb      :
*-----:-----
MIGNsayear      na      : Input net numbers of
  migs 1      migs 2      migs 3      migs 4      migs 5      etc.      : international migrants.
MIGRsyear      na      : Input net international
  rate 1      rate 2      rate 3      rate 4      rate 5      etc.      : migration rates.
RUMNsyear      na      : Input net numbers of
  migs 1      migs 2      migs 3      migs 4      migs 5      etc.      : internal migrants.
RUMRsyear      na      : Input net internal
  rate 1      rate 2      rate 3      rate 4      rate 5      etc.      : migration rates.
*-----:-----
OUTPsayear      frq      yrf      dsrn      : Detailed output.
OPOPsayear      frq      yrf      dsrn      : Population output.
OMX sayear      frq      yrf      dsrn      : Mx or life table output.
ODTHsayear      frq      yrf      dsrn      : Output deaths by age/sex.
OBTHsayear      frq      yrf      dsrn      : Output births by age.
*-----:-----
END      : End of projection.
*-----:-----
NOTE      nn      : Notes to describe inputs,
notes go here ..      : etc.
*-----:-----
* comment      : Comments on inputs, etc.
*-----:-----
*      10      20      30      40      50      60      70      80:
*-----:-----

```

4. RUP Input Summary (continued; symbol definitions)

Symbol	Definition	Symbol	Definition
a	(column 6) age grouping 0 or blank = default	region	Coale-Demeny model life table region to be used, if needed
1	= single years of age	1	= West
4	= ages 0, 1-4, 5-9, 10-14, etc.	2	= North
5	= ages 0-4, 5-9, 10-14, etc.	3	= East
9	= total, all ages (MIGN and RUMN only)	4	= South
adj	if > 0, adjust mx for ages 1, 2, 3, 4	s	(column 5) sex code 0 or blank = default B = Both sexes E = Each sex, (male, then female) F = Female M = Male
age	lower limit of age group		
arnum	area number	sep0	separation factor age 0
bsbth	total births both sexes	sep0f	female separation factor age 0
bsdth	total deaths both sexes	sep0m	male separation factor age 0
bsexb	both sexes births	sep1	separation factor ages 1-4
bsexd	both sexes deaths	sxrb	sex ratio at birth (male/female)
dsrn	data set reference number	tfr	total fertility rate
e0	life expectancy at birth	tpop	total population
fbth	total births female	un	upper age, special group n
fdth	total deaths female	wid	width of age group
femd	female deaths	year	year to which data refer
frq	frequency of output	yend	ending year of the projection
ia	initial age of ASFR data	yrf	final year to print
ln	lower age, special group n		
maled	male deaths		
mbth	total births male		
mdth	total deaths male		
na	number of ages of data		
nage1	# of single ages to use in the projection		
nage5	# of 5-year ages to use in the projection		
nn	number of note records		
nspag	# of special ages		
ntit1	number of TITL records		
p0	population under age 1		

B. Installation and Operation

1. Installation

See separate installation instructions.

2. Operation

See the separate RUPEX documentation.

2.1 Input File

The RUP program will prompt you for the input file name. Any legal file name (including the drive and path) is permitted. If no drive or path is specified, the default drive and path will be used (usually the drive and path where the RUP.EXE file is located). For the input file extension, you can use anything except ".OUT," ".IO1," ".IO2," ".AGG," or ".CMB," but the extension ".IN" is recommended.

The RUPEX interface assumes that the extension is ".IN" and that the first part of the name is no more than 7 characters.

The RUP program will notify you if it cannot find your input file. In this case, you have the options either to stop the run or to re-enter the file name (e.g., if you spelled it wrong or indicated the wrong drive and/or directory).

2.2 Output Files

The RUP program will use the first 7 characters of the name of the input file to construct the output file names. If you specify a drive and/or path, they will be retained as well. For example:

Item	Sample 1	Sample 2
Input file	A:IRELAND.IN	C:\123\BOTSWANA.PRN
Input listing	A:IRELAND.OUT	C:\123\BOTSWAN.OUT
Table 1	A:IRELAND1.OUT	C:\123\BOTSWAN1.OUT
Table 2	A:IRELAND2.OUT	C:\123\BOTSWAN2.OUT
Full Page	A:IRELANDF.OUT	C:\123\BOTSWANF.OUT
Intermediate 1	A:IRELAND.I01	C:\123\BOTSWAN.I01
Intermediate 2	A:IRELAND.I02	C:\123\BOTSWAN.I02
Population (OPOP)	A:IRELANDP.OUT	C:\123\BOTSWANP.OUT
Mx output (OMX)	A:IRELANDM.OUT	C:\123\BOTSWANM.OUT
Death output (ODTH)	A:IRELANDD.OUT	C:\123\BOTSWAND.OUT
Birth output (OBTH)	A:IRELANDB.OUT	C:\123\BOTSWANB.OUT

The "input listing" file is the echo of the input file with any error messages, etc.

The RUP program will notify you if it finds that the listing file already exists. In this case, you can choose to overwrite the file (for example, if you are re-running the program after correcting the input data). Due to the file name structure, the program will give you a warning only for the listing

file on the assumption that, if you want to replace it, you will want to replace the others with the same name scheme.

While the program is running, it will display a summary of the projection on the screen.

When the projections for all areas are completed successfully, the program will display the message "Stop - Program terminated" and return to the DOS prompt.

The program produces error or warning messages if it detects problems with the projection. An error message indicates a severe problem that prevents the program from continuing. A warning indicates a potential problem that should be investigated. When RUP detects an error or warning condition, it writes a message to the listing file and the program will display the following messages at the end of the projection (or when the error occurs):

CHECK OUTPUT LIST FILE FOR ERRORS/WARNINGS

```
*** NUMBER OF ERRORS/WARNINGS =   xx
FOR DETAILS, CHECK OUTPUT LISTING FILE file.OUT
```

If there was at least one severe error, the following message will also be displayed:

```
*** AT LEAST ONE SERIOUS ERROR WAS FOUND ***
```

The first type of error is a problem with the input file. Check the message in the input listing file and correct the error indicated. To check the input listing file, you can use the RUPLEX interface to view or print it.

In other cases, the program does not detect an error in the input, but the program cannot continue due to an error in the projection, or the program has detected a situation which may produce unreliable results. The program may detect such an error and print an error message, usually indicating a value outside of the expected range. In this case, look at the listing file (as indicated above) and examine both your input and the output that was produced to determine where and why the error may have occurred. Focus on the last year of output printed and examine the input for the following and subsequent years (e.g., MX records for an ultimate life table, if the next mortality inputs are MXM records).

In some situations, the RUP program will not detect any error, but the program still cannot continue. This will generate a "run-time error" (e.g., division by zero). In this case, you will have less information to work with (e.g., you will not know whether the program was working with fertility or mortality input when the error occurred). Again, examine all the outputs (input listing, summary tables, full-page output) to determine the location of the data that caused the problem.

Refer to Part H for a list of RUP error messages and suggestions for correcting them.

2.3 Printing

See Addendum A: RUPEX documentation.

C. Creating RUP Input Files

RUP input files can be created and modified in any program capable of reading, editing, and writing out ASCII files. Text editors that are designed for use with ASCII files are the best. For RUPEX, the default Windows program "Notepad" is recommended.

D. Documentation: RUP

1. General Structure of Input to RUP

The input to RUP consists of three types of records: parameter records, data records, and comment records. This section will give a general description of these record types.

Parameter records serve three functions:

- (1) Describe certain aspects of the projection (e.g., the TOT record indicates that the records that follow apply to the total area projection).
- (2) Define parameters of the projection (e.g., the PROJ record designates the final year of the projection).
- (3) Introduce certain data records.

The parameter records follow a fixed format as described in Section 1.1.2, page 27. The parameter records recognized by the program are shown in Table 1.

Data records contain data of a repetitive nature and allow for formats specific to the information they contain (e.g., character data for the title records and 10-column fields of numeric data for the base population by age and sex). Data records always immediately follow their associated parameter record. The formats of the data records are described in the section that describes the associated parameter record.

Comment records allow the user to document the source of input data, separate types of data, etc.

Table 1. RUP Parameter Records and Their Functions

Type	Function
TITL	Precedes records with descriptive information to be printed on each page of output.
N5	Specifies the number of 5-year age groups to be used in the projection.
N	Specifies the number of single years of age to be used in the projection.
SPAG	Specifies the special age groups for which population data are to be printed.
PROJ	Specifies the final year of the projection.
REG	Specifies a Coale-Demeny model life table region.
SXRB	Specifies the sex ratio at birth.
AREA	Initiates input of parameter records which describe the projection for a particular area or group.
CODE	Specifies a code number to be associated with a particular area or group. Including the code record causes the program to create the intermediate file.
TOT	Initiates input of parameter records which control the total population phase.
POP	Specifies the base year of the projection and precedes the base-year population data.
MX	Initiates input of age-sex-specific central death rates.
QX	Initiates input of age-sex-specific mortality rates.
MXM	Specifies a desired life expectancy at birth.
MLT	Specifies the life expectancy at birth of a Coale-Demeny model life table.
DTH	Specifies deaths by age and sex.
ASFR	Initiates the input of age-specific fertility rates.
TFR	Specifies a desired level of the total fertility rate.
BTH	Specifies births by age of mother.

Table 1. RUP Parameter Records and Their Functions (Continued)

Type	Function
MIGN	Initiates the input of the net number of international migrants by age and sex.
MIGR	Initiates the input of age-sex-specific net international migration rates.
RUMN	Initiates the input of the net number of internal migrants, by age and sex.
RUMR	Initiates the input of age-sex-specific net internal migration rates.
OUTP	Controls full-page output.
OPOP	Controls special population output.
OMX	Controls age-sex-specific central death rate output.
OBTH	Controls output of births, by age of mother.
ODTH	Controls output of deaths, by age and sex.
END	Specifies the end of the projection inputs.
NOTE	Allows the inclusion of descriptive notes that are printed only as encountered during input.
EDIT	Allows scanning of parameter and data records without projecting.

1.1 Parameter Records

1.1.1 Parameter Record Order

The parameter records and any associated data records must follow certain rules regarding where they are located in the input to RUP. Table 2 shows the 11 order groups where the parameter records are to be included and indicates whether or not the records are required. The sequence of parameter records within the order groups is not important as long as the appropriate number of data records for each parameter record are included.

Table 2. Parameter Record Order for RUP

Phase	Order	Parameter Records*
0	1	(EDIT)
0	2	TITL, [N5, N], PROJ, (SPAG), (REG), (SXRБ)
1	3	[AREA, TOT]
1	4	(REG), (SXRБ), (CODE), POP, {MX, QX, MLT}, (DTH), (MXM), ASFR, (BTH), (TFR), ([MIGN, MIGR]), ([RUMN, RUMR])
1	5	(OUTP, OMX, OPOP, ODTН)
(2)	(6)	([AREA, TOT])
(2)	(7)	(REG), (SXRБ), (CODE), POP, {MX, QX, MLT}, (DTH), (MXM), ASFR, (BTH), (TFR), ([MIGN, MIGR]), ([RUMN, RUMR])
(2)	(8)	(OUTP, OMX, OPOP, ODTН)
(3)	(9)	([TOT, AREA])
(3)	(10)	(OUTP, OMX, OPOP, ODTН)
None	11	END

* Symbols (where A and B represent parameter record names):

A Parameter record A is required in this location.

(A) Parameter record A is optional in this location.

[A, B] Choose only one parameter record, A or B.

{A, B} Choose at least one parameter record, A or B or both.

Notes: The sequence of parameter records within a given order group is not important except for the DTH records. Each DTH record must: (1) have an MX, QX, MLT, or DTH record for the year prior to the year of death data, and (2) be followed by an MX, QX, or MLT record for a later date.

REG and SXRБ must be specified in order 2 or order 4.

They must be specified in order group 7 if present.

The NOTE parameter record and associated notes or the * comment records can be placed at any location in the run where a parameter record is expected.

If only one or two phases are desired (selected from rural, urban, and total), do not include any of the records for the later phases (i.e., do not include records in orders 6-10 if only one phase is desired, or do not include records in orders 9 and 10 if only two phases are desired).

The TOT record can appear only once in a particular run, and the AREA records can appear only twice. Data for each component must be entered in chronological order. The components are: mortality (MX, QX, MXM, DTH, OR MLT input), fertility (ASFR, TFR, or BTH input), international migration (MIGN or MIGR input but not both), and internal migration (RUMN or RUMR, but not both). SXRB and BTH records must be in chronological order because they both can affect the sex ratio at birth.

1.1.2 Parameter Record Format

In the following description of the various inputs to the program, the record layout is as shown below for each parameter record:

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
typesayear  value1  value2  value3  value4  value5
*-----|-----|-----|-----|-----|-----|
```

The fields used for a particular parameter record are shown by the field name in the record layout. The *type*, *s* (sex), *a* (age), and *year* fields are specified on many parameter records. These fields are described generally in this section, and exceptions to these rules are indicated later in the description of the specific parameter records.

Record	Columns	Field	Definition
1	1-4	<i>type</i>	Each record type is composed of 1 to 4 characters which are left-justified (i.e., they begin in column 1). Table 1 contains a list of the valid parameter record types and a summary of their functions.
	5	<i>s</i>	The sex of the population data: M = Male F = Female E = Each sex (male, then female) B = Both sexes (not usually permitted)
	6	<i>a</i>	Age grouping of the data: 0 or blank = default age grouping: 1 if <u>N</u> record present 5 if <u>N5</u> record present 1 = Single years of age 4 = Ages 0 (under 1), 1-4, 5-9, etc. 5 = Ages 0-4, 5-9, etc. 9 = All ages (not usually permitted)

Record	Columns	Field	Definition
1	7-10	year	Year to which the data refer. Remember that the fertility, mortality, and migration data for a particular year refer to the year centered on the date of the population data. The year entered on a parameter record can be a year outside the projection period. For example, a base life table (<u>MX</u> or <u>QX</u> input) can refer to a year prior to the beginning of the projection; or an "ultimate" life table can be input for a year after the final year of the projection, to be used for interpolating mortality data for intermediate years. The year on the <u>POP</u> record defines the beginning of the projection period, and the year on the <u>PROJ</u> record defines the end of the projection period.

Additional information may be included on some parameter records. These values are coded in successive 10-column fields (value1 through value5 in the record layout above), starting with columns 11-20. These values should be right-justified. If a decimal point is required, this will be indicated in the description of the particular field on the parameter record.

1.2 Data Records

In many cases, the parameter record is used to describe the type of data that follows. The data records are usually composed of eight 10-column fields, columns 1-10 through 71-80. The proper number of data records must be included to satisfy the requirements specified on the parameter record. This will depend on

- (1) The number of age groups specified on the N5 or N record or on the parameter record.
- (2) The format of the data (i.e., whether the data are in single years or 5-year age groups).

When absolute numbers are being coded, they should be right-justified; and the decimal point need not be included. For rates, on the other hand, the decimal point must be specified. It is helpful to line up the rate values (whether right- or left-justified, or even centered) to make it easy to check the data for errors.

2. General Information Input Records

The records described in this section define parameters that generally remain in effect throughout all three phases of the projection (i.e., rural, urban, and total). These records must be included in the input to the first phase, unless the default options are desired.

2.1 The TITL Record: Description of the Projection

The TITL record is used to inform the program that one or more records will follow that contain descriptive information about the projection (e.g., the country, the source of the base data, the fertility assumptions). Information on the title records will be printed on every page of output.

Layout for the TITL parameter record and associated data records:

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
TITL      ntitl
title
*-----
```

Record	Columns	Field	Definition
1	1-4	TITL	The characters 'TITL' in this field indicate that this is a <u>TITL</u> parameter record
	20	ntitl	Number of title records that follow. This number must be less than or equal to 7, and the sum of <i>ntitl</i> plus <i>nspag</i> (number of additional special age groups on the <u>SPAG</u> record, see page 33) must be less than or equal to 8. If <i>ntitl</i> is zero or blank, a value of 1 is assumed.
2	1-80	title1	Title record number 1.
...			...
<i>ntitl</i> +1	1-80	titlen	Title record number <i>ntitl</i> .

Example: Print a heading on each page of output

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |
TITL      2
EGYPT
LOW FERTILITY
*-----
```

The two lines:

EGYPT
LOW FERTILITY

will be printed at the top of each page.

2.2 The N5 Record: Number of 5-Year Age Groups

The N5 record tells the program how many 5-year age groups of data to use in the projection. The N5 record also informs the program that the default input format will be 5-year age groups. One N5 or N record must be included in every projection.

The program assumes that all input data are in *nage5* 5-year age groups, unless it is told there are more age groups for a particular type of record (e.g, the POP record) and/or the age grouping is different. However, the number of age groups used and printed will be N5.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
N5              nage5
*-----
```

Record	Columns	Field	Definition
1	1-4	N5	Indicates this is an <u>N5</u> parameter record.
	19-20	<i>nage5</i>	The number of 5-year age groups from ages 0 to 4 years up to and including the last, open-ended age group. The value of <i>nage5</i> must be in the range 11 to 21, corresponding to open-ended age groups of 50 years and over and 100 years and over, respectively.

Example: Specify the number of 5-year age groups

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
N5              17
*-----
```

There are 17 5-year age groups, from 0-4 to 80+.

2.3 The N Record: Number of Single Years of Age

The N parameter record tells the program how many single years of age of data to use in the projection. The N record also informs the program that the default input format will be single years of age.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
N      nage1
*-----
```

Record	Columns	Field	Definition
1	1-4	N	Indicates this is an <u>N</u> parameter record.
	18-20	nage1	The number of single-year age groups, from age 0 (under 1) up to and including the last, open-ended age group. The value of <i>nage1</i> must be in the range 51 to 101, corresponding to open-ended age groups of 50 years and over to 100 years and over, respectively.

Example: Specify the number of single years of age

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
N      101
*-----
```

The default age grouping is single years of age, and there are 101 ages, from 0 to 100+.

2.4 The PROJ Record: Final Projection Year

The PROJ record is used to indicate the final year of the projection. One PROJ record with a *yend* value greater than or equal to 0 is required for each run.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
PROJ  yend
*-----
```

Record	Columns	Field	Definition
1	1-4	PROJ	Indicates this is a <u>PROJ</u> record.
	7-10	yend	Ending year of the projection.

Example: Specify the final year of the projection

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
PROJ  1995
*-----
```

The population should be projected to the year 1995.

2.5 The SXRБ Record: Sex Ratio at Birth

The SXRБ record provides the value of the sex ratio at birth.

*-----						
* 10 20 30 40 50 60 70 80						
*----- ----- ----- ----- ----- ----- ----- -----						
SXRБ						
*-----						

Record	Columns	Field	Definition			

1	1-4	SXRБ	Indicates this is an <u>SXRБ</u> record.			
	7-10	year				
	11-20	<i>sxrb</i>	Sex ratio at birth (number of male births per female birth). The value of <i>sxrb</i> must be in the range 0.9 to 1.15. The decimal point must be included in the input value.			

Example: Specify the sex ratio at birth

*-----								
*	10	20	30	40	50	60	70	80
*								
SXRБ		1.05						
*-----								

The sex ratio at birth is 1.05 males per female.

Since the urban and rural projections are done separately, a different sex ratio at birth can be specified for each area.

Alternatively, the sex ratio at birth is implied when births by sex are entered on the BTH record (see page 55). The value implied by a BTH record replaces the value on the SXRБ record and remains in effect until another BTH record is reached.

Since the SXRБ and BTH records both can determine the sex ratio at birth, the sequence of these records must be in chronological order. Thus, if BTH data are input by sex for several years and then you want to use a sex ratio at birth different from that implied by the last BTH input, the SXRБ input must follow the last BTH input.

2.6 The SPAG Record: Special Age Groups

The SPAG record allows the user to enter special age groups in addition to those that are included automatically. Population in special age groups is printed along with the population in 5-year age groups. Special age groups included automatically are as follows:

0 (Under 1)
 1-4
 0-14
 15-24
 15-44
 15-49
 15-64
 50-64
 55+
 65+
 75+

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
SPAG      nspag
  11    u1  12    u2  13    u3  14    u4  15    u5  16    u6  17    u7
*-----
```

Record	Columns	Field	Definition
1	1-4	SPAG	Indicates a <u>SPAG</u> record.
	20	<i>nspag</i>	The number of special age groups. This number must be less than or equal to 7, and the sum of <i>nspag</i> plus the number of title records (<i>ntitl</i>) must be less than or equal to 8.
2	1-5	11	Lower limit of the first special age group *.
	6-10	u1	Upper limit of the first special age group *.
	11-15	12	Lower limit of the second special age group *.
	16-20	u2	Upper limit of the second special age group *.

	61-65	17	Lower limit of the seventh special age group *.
	66-70	u7	Upper limit of the seventh special age group *.
*	-	Specify the ages in completed years (e.g., to specify the Age group "under 15," code 0 as the lower limit and 14 as the upper limit).	
	-	To specify a single year age group, code identical lower And upper limits.	
	-	If an age is entered that is greater than or equal to the initial age of the open-ended age group, the whole open-ended age group will be included.	
	-	A blank field will be read as zero (0).	
	-	Right-justify the age group limits in the 5-column fields.	

The maximum number of additional special age groups that can be specified is seven (7), but the number of special age groups plus the number of title records (see page 29) must be less than or equal to eight ($nspag + ntitl \leq 8$).

Example: Specify additional special age groups

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
SPAG      7
      0      0      1      1      2      2      3      3      4      4      6      11      62      999
*-----
```

The population in the age groups 0, 1, 2, 3, 4, 6-11, and 62 years and over will be printed.

2.7 The REG Record: Coale-Demeny Model Life Table Region

The REG record is used to specify the Coale-Demeny model life table region to be used for (1) determining separation factors, (2) splitting mortality for ages 1-4, and/or (3) creating model life tables.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
REG      region
*-----
```

Record	Columns	Field	Definition
1	1-3	REG	Indicates a <u>REG</u> record.
	20	region	The code for the Coale-Demeny model life table region desired: 1 = West 2 = North 3 = East 4 = South

If no REG record is included, the west region will be used.

Example: Specify a Coale-Demeny model life table region

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
REG      2
*-----
```

The north region model should be used.

3. Area Selectors, Codes, and Intermediate Files

When a two-region projection is desired, the user must indicate the names of the regions and the data for performing the projection for those areas. This is accomplished by the AREA and TOT records. Each AREA or TOT record signifies the beginning of data for a new area.

The RUP program uses intermediate files to do aggregations (for example, it uses urban and rural data to get total country results). When the program is used to project the whole country's population, there is usually no need to create an intermediate file, since creating it (a) would slow down the program, and (b) may cause the program to run out of disk space and end prematurely.

In addition to allowing two-area projections (e.g., rural and urban or total and rural), with the resulting total or residual, the intermediate files can also be used as input to the RUPAGG program. See separate documentation of the RUPAGG program.

In order to address this situation, the RUP program creates the intermediate file only if it is explicitly instructed to do so by including a CODE record, usually inserted immediately after the AREA record (and area label data record) or TOT record.

3.1 The AREA Record: Area Selector

The AREA record indicates the beginning of data for a particular area, subarea, or group. The AREA record is followed by a data record which contains the name of the area or group (for example, URBAN, RURAL, BLACK, or NATIVE BORN).

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
AREA
areanm
*-----
```

Record	Columns	Field	Definition
1	1-4	AREA	Indicates this is an <u>AREA</u> record.
2	1-80	areanm	Name of the area or group being projected.

3.2 The TOT Record: Total Country

The TOT record indicates that the following input refers to the total country (or other unit). The TOT record consists only of the letters "TOT" in columns 1-3 of the record. In phase 1 (see order group 3 in Table 2, page 25), it can be used to specify a total country projection which may or may not be followed by an AREA record in phase 2. If the TOT record is in phase 1 or 2, then an AREA record is required for phase 3 to compute the residual population projection. Similarly, a TOT record is needed in phase 3 to indicate that an aggregation of the data for the AREAs in phases 1 and 2 is desired.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
TOT
*-----
```

3.3 The CODE Record: Area Reference Number for Intermediate File

The CODE record specifies the area reference number to help identify the data and indicates that the projected data should be stored in an intermediate file for later aggregation.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
CODE          arnum
*-----
```

Record	Columns	Field	Definition
1	1-4	CODE	Indicates this is a <u>CODE</u> record.
	5-14	blank	
	15-20	arnum	Area reference number. This number must be right-justified.

Example: Select the area to be projected

```
*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
...
AREA
URBAN
CODE          1
....
AREA
RURAL
CODE          20
...
TOT
*-----
```

A three-phase projection is desired. The first area, urban, is assigned the arbitrary number 1 and the second area, rural, is assigned the arbitrary number 20. The results of each of the first two areas will be stored in intermediate files and summed to derive the total.

4. Projection Parameters

The parameter records described in this section define the base population, mortality, fertility and international and internal migration data to be used in projecting the urban, rural, and/or total populations.

In general, all of the projection parameter records (and corresponding data records) of a particular type for a particular year must be together. Where applicable, data must be provided for each sex (or both sexes combined). Also, the component data (fertility, mortality, and migration) must be in chronological order within each component. Other than these restrictions, the order of records in this section is flexible. Thus, the user can either put all the data for one component together or alternate the data so the inputs for all components are in chronological order.

4.1 The POP Record: Base Population

The POP record and the population data that follow are used to input the base population data.

```
*-----*
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
POP sayear      na      p0      tpop
      pop 1      pop 2      pop 3      pop 4      pop 5 etc.
*-----|-----|-----|-----|-----|-----|-----|
```

Record	Columns	Field	Definition
1	1-3	POP	The characters `POP' to identify population data.
	5	s	The sex of the population data: M = Male F = Female E = Each sex (male then female)
	6	a	Age grouping of the data: 0 or blank = default age grouping 1 if <u>N</u> record provided 5 if <u>N5</u> record provided 1 = Single years of age 4 = Ages 0 (under 1), 1-4, 5-9, etc. 5 = Ages 0-4, 5-9, etc. (the population age 0 can be entered in columns 21-30 of this record).

Record	Columns	Field	Definition
1	7-10	<i>year</i>	Year to which the population data refer; in this case, the base year of the projection. <u>POP</u> records after the first can have a blank year field, in which case the same year is assumed for all <u>POP</u> records.
	11-20	<i>na</i>	Number of age groups for the program to read. This number can be greater than the figure specified on the <u>N5</u> or <u>N</u> record, in which case the program will add together the populations in the last age groups in order to obtain the number of age groups specified on the <u>N</u> or <u>N5</u> record.
	21-30	<i>p0</i>	The population age 0 (under 1). This allows the user to input the population data in 5-year age groups (<i>a=5</i>), but still include an estimate for age 0. The inclusion of the age 0 population results in a better splitting of the population into single years of age.
1	31-40	<i>tpop</i>	Total population for this sex. This allows the user to input a total population that is different from the sum of the population figures by age. This can be useful if an independent total was determined (e.g., by a post-enumeration survey) but you want to use the same distribution by age. If you enter a figure <i>tpop</i> , the population data by age are proportionately adjusted to that total.
2	1-10	<i>pop1</i>	Population data for first age group.
	11-20	<i>pop2</i>	Population data for the second age group.
	...		
	71-80	<i>pop8</i>	Population data for the eighth age group.
3	1-10	<i>pop9</i>	Population data for the ninth age group.
...	...		etc.

Example 1: Input the population by 5-year age groups

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
POP M51950      40100
    172500    141200    122000    105400    90100    76500    64600    54100
    44800    36600    29200    22600    16600    11400    7000    3600
    1800
*-----

```

Male population data are entered for 17 5-year age groups (0-4 through 80+). The population under age 1 (40,100) is entered on the POP record.

In some cases, you may wish to specify the population by single years of age for part of the age distribution (e.g., the population ages 0 to 4) while using the BEERS split¹ population for the remaining ages. This can be accomplished by first including a POP record with an age code of 5 followed by the population in 5-year age groups, then coding a second POP record indicating single year data with na=5 followed by the data for ages 0, 1, 2, 3, and 4. This is the only case where na can be less than N.

Example 2: Provide supplementary population data by single years

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
POP M51950      40100
    172500    141200    122000    105400    90100    76500    64600    54100
    44800    36600    29200    22600    16600    11400    7000    3600
    1800
POP M11950      5
    40100    35985    33571    31977    30867
*-----

```

If this method is used to input single-year age data for selected ages, the 5-year data for all ages must appear first (to allow preliminary splitting), and all the data for one sex must be together.

Example 3: Adjust the population data to a new total

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
POP M51950      40100    1200000
    172500    141200    122000    105400    90100    76500    64600    54100
    44800    36600    29200    22600    16600    11400    7000    3600
    1800
*-----

```

The sum of the data by age is only 1,000,000. Each figure will be multiplied by the ratio 1,200,000/1,000,000 so the initial total male population will be 1,200,000.

¹H. S. Beers. 1945. "Modified-Interpolation Formulas That Minimize Fourth Differences," Record of the American Institute of Actuaries, Vol. 34, June, pp. 14-61.

4.2 Mortality Parameter Records

The RUP program allows the mortality of the population to be described in different ways, depending on the quality of the base mortality data and the types of assumptions about changes in mortality that you wish to make.

The methods used for estimating the separation factor are summarized in Table 3. All of the mortality input types (except MLT) allow you to input the separation factor for infant deaths. If no separation factors are provided as input, then the Coale-Demeny formula relating the separation factor to the infant mortality rate will be used (see part G, section 4, page 77).

If at least one separation factor is provided as input, the method may vary. For any mortality input where the separation factor is specified, it will be used. For any other input without separation factors, the method depends on the type of input. For MX, QX, DTH, and MXM (extrapolation) input, the Coale-Demeny formula will be used. For MXM interpolation input, the separation factor will be linearly interpolated using the same interpolation factors as for the ${}_n m_x$ values. For years between mortality inputs, the separation factors will be linearly interpolated.

Table 3. Methods for Estimating the Separation Factor for Infant Deaths

Mortality estimate type	No sep0's entered	At least one sep0 entered	
		sep0 on this parameter record	sep0 not on this parameter record
MLT	CD	(X)	CD
MX or QX	CD	sep0	CD
DTH	CD	sep0	CD
MXM (interp.)	CD	sep0	interpolate using mx factors
MXM (extrap.)	CD	sep0	CD
Intermediate year	CD	(X)	interpolate using year

X Not applicable.

CD Uses Coale-Demeny formula.

sep0 Uses the input separation factor (sep0) on the parameter record.

4.2.1 The MX Record: Age-Sex-Specific Central Death Rates

The MX record initiates the input of age-sex-specific central death rates, ${}_n m_x$. The MX record is preferable to the QX record (see below) because it allows you to specify the level of mortality in the open-ended age group.

*-----						
*	10	20	30	40	50	60 70 80
*----- ----- ----- ----- ----- ----- -----						
MX	sayear	sep0	sep1	na	adj	
	mx1	mx2	mx3	mx4	mx5	etc.
*-----						
Record	Columns	Field	Definition			
1	1-2	MX	The characters 'MX' in columns 1-4 indicate that this is an <u>MX</u> record.			
	5	s	The sex of the population data: M = Male F = Female E = Each sex (male then female)			
	6	a	Age grouping of the data: 0 or blank = default age grouping: 1 if <u>N</u> record provided 4 if <u>N5</u> record provided 1 = single years of age 4 or 5 = ages 0 (under 1), 1-4, 5-9, etc.			
	7-10	year	Year to which the data refer.			
	11-20	sep0	Separation factor for infant deaths. Include the decimal point in the value. If this value is blank or 0, the Coale-Demeny equations will be used to estimate an appropriate value based on the region code entered on the <u>REG</u> record.			
	21-30	sep1	Separation factor for deaths, ages 1 to 4 years. Include the decimal point in the value. If this value is blank or 0, the Coale-Demeny equations will be used to estimate an appropriate value based on the region code entered on the <u>REG</u> record.			

Record	Columns	Field	Definition
	31-40	<i>na</i>	Number of age groups of data to be read. If you want to use the default values, enter blank or 0 in this field. The default values are: <i>nage1</i> if <i>a</i> = 1 <i>nage5</i> + 1 if <i>a</i> = 4 or 5 This value can be less than these default values only when supplementary rates by single years of age are being entered. It can never be greater than the default value.
	41-50	<i>adj</i>	Adjustment flag. A non-zero value indicates that the single-year death rates for ages 1, 2, 3, and 4 years (created in the program based on the death rate for ages 1-4 and the separation factor for ages 1-4) should be adjusted in order to reproduce the input death rate for ages 1 to 4. This provision applies only to the rates for the base year of the projection, and it is available to insure correspondence between the number of deaths based on single years of age and those based on ages 0, 1 to 4 years, and 5-year age groups beginning with 5 to 9 years. If you select the <i>adj</i> option, the separation factor, <i>sepl</i> , may not be preserved.
2	1-10	<i>mx1</i>	Age-specific central death rate for the first age group, ${}_1m_0$.
	11-20	<i>mx2</i>	Age-specific central death rate, second age group: ${}_1m_1$ if <i>a</i> = 1 ${}_4m_1$ if <i>a</i> = 4 or 5
	21-30	<i>mx3</i>	Age-specific central death rate, third age group: ${}_1m_2$ if <i>a</i> = 1 ${}_5m_5$ if <i>a</i> = 4 or 5

	71-80	<i>mx8</i>	Age-specific central death rate, eighth age group: ${}_1m_7$ if <i>a</i> = 1 ${}_5m_{30}$ if <i>a</i> = 4 or 5
...	etc.

Note: The decimal point must be included in all rates. Rates are expressed as annual deaths per person-year lived.

Example 1: Provide age-specific central death rate (${}_n m_x$) input for an abridged life table.

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
N5      17
...
MX  F41950
    0.16145  0.02496  0.00551  0.00429  0.00576  0.00732  0.00827  0.00939
    0.01047  0.01157  0.01313  0.01748  0.02318  0.03468  0.04952  0.07575
    0.11440  0.22752
*-----

```

Central death rates for females for the year 1950 have been entered for the age groups 0, 1-4, 5-9, etc. The last value shown (0.22752) is the central death rate for women 80 years and older in 1950.

Example 2: Provide supplementary single-year central death rate (${}_1 m_x$) input

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
N5      17
...
MX  F41950
    0.16145  0.02496  0.00551  0.00429  0.00576  0.00732  0.00827  0.00939
    0.01047  0.01157  0.01313  0.01748  0.02318  0.03468  0.04952  0.07575
    0.11440  0.22752
MX  F11950      5
    0.16145  0.04000  0.03000  0.02000  0.01000
*-----

```

Supplementary data for single years of age up to a certain age can be read in after the 5-year data in a similar manner to that described in Section 4.1 for population data (see example 2, page 39). The single-year ${}_1 m_x$ values for ages 0, 1, 2, 3, and 4 have been entered after the ${}_1 m_0$, ${}_4 m_1$, and ${}_5 m_x$ values for 5-year age groups, beginning with ages 5-9 years.

4.2.2 The QX Record: Age-Sex-Specific Probabilities of Dying

The QX record is similar to the MX record and indicates that the mortality data are in the form of age-specific probabilities of dying rather than age-specific central death rates. The *adj* option is not relevant when the input data are ${}_nq_x$ values. If the mortality information is specified as age-specific mortality rates (${}_nm_x$ values following a QX record), then the program will convert these to age-specific central death rates (${}_nq_x$) for the projection.

```
*-----
*          10          20          30          40          50          60          70          80
*-----|-----|-----|-----|-----|-----|-----|-----|
QX  sayear      sep0      sep1      na
     qx1        qx2        qx3      qx4      qx5  etc.
*-----
```

The data record format is the same as that indicated in the MX record description (see pages 41-43).

4.2.3 The MLT Record: Coale-Demeny Model Life Tables

The MLT record indicates that the mortality data should be generated based on a Coale-Demeny regional model life tables.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
MLT sayear      e0
*-----
```

Record	Columns	Field	Definition
1	1-3	MLT	Indicates an <u>MLT</u> record.
	5	s	The sex of the population data: M = Male F = Female
	6	a	Age grouping of the data. Although no data records follow this record, the age code indicates how the life table should be constructed. 0 or blank = default age grouping: 1 if <u>N</u> record provided 5 if <u>N5</u> record provided 1 = Single years of age 5 = 5-year age groups If a = 1, age-specific central death rates will be obtained so that the complete life table will reproduce the specified e0 value. This procedure assumes, for ages 5 years and over, that each single-year central death rate in a given 5-year age group equals the 5-year age group central death rate.
	7-10	year	Year to which the data refer.
	11-20	e0	Life expectancy at birth. The decimal point must be included in the e0 value. If an <u>MLT</u> record for one sex is followed by an <u>MLT</u> record for the opposite sex for the same year, the corresponding Coale-Demeny expectation of life at birth for the second sex can be obtained by coding 99.0 as the e0 value.

4.2.4 The MXM Record: Modification of Age-Sex-Specific Death Rates

The MXM record indicates that age-specific central death rates ($n\text{m}_x$) are to be estimated in order to obtain the expectation of life at birth ($e0$) value specified in columns 11 to 20.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
MXM s year      e0      sep0
*-----
```

Record	Columns	Field	Definition
1	1-3	MXM	Indicates an <u>MXM</u> record.
	5	s	The sex of the population data: M = Male F = Female
	7-10	year	Year to which the data refer.
	11-20	e0	Expectation of life at birth desired for this year.
	21-30	sep0	Separation factor for infant deaths. If the separation factor is entered, it is used in the life table. If the <i>sep0</i> field is blank or 0, refer to Table 3, page 40, for the method used to estimate the value.

The MXM record operates in tandem with the other mortality information provided as input. If a life table is defined for an earlier year (MX, QX, MLT, or DTH record) and a later year (MX, QX, or MLT), then the program will linearly interpolate the logarithms of the $n\text{m}_x$ values in order to obtain the specified life expectancy at birth ($e0$ in columns 11-20). This is the preferred method because the surrounding life tables place limits on the possible values of the interpolated rates. In general, each projection will begin with an estimated life table based on available data. You can project future levels of life expectancy by fitting a function to the available data or by other analysis. For the last year of the projection, you can select or construct a life table or specify an "ultimate" life table for a year beyond the projection period with a life expectancy exceeding the one projected for the last year of the projection. Finally, you can use the MXM records to plot the course of life expectancy between the base and final life tables.

In order for this interpolation procedure to work properly, the life expectancies specified on the MXM records must be within the range of those implied by the surrounding life tables that will be used for the interpolation. If they are outside that range, the program will extrapolate instead of interpolate and will display a warning message because the resulting $n\text{m}_x$ values may be unrealistic. The extrapolated values could even be negative or greater than 1, in which case the program would stop.

An alternate procedure is used if two surrounding life tables are not available. In this case, the program extrapolates the age-specific central death rates using the age pattern of mortality in the nearest input empirical

life table and the age-specific pattern of changes in mortality implied by the Coale-Demeny model life tables. The MXM record can be used to produce life tables for years prior to or following those years for which empirical life tables are available. This alternate procedure can also produce unrealistic results, depending on how close the empirical life table pattern is to the selected Coale-Demeny model.

Example 1: Interpolate to estimate age-specific central death rates.

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
PROJ  2050
...
* BASE EMPIRICAL LIFE TABLE
MX   M41980
...
MX   F41980
...
MXM M 1990      60.00
MXM F 1990      65.00
...
* ULTIMATE LIFE TABLE
MX   M42100
...
MX   F42100
...
*-----

```

The life tables for 1990 will be computed by interpolating between the 1980 life tables and the 2100 "ultimate" life tables to obtain life expectancies at birth of 60.00 and 65.00 for males and females, respectively.

Example 2: Extrapolate to estimate age-specific central death rates.

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
PROJ  2050
REG              1
...
MXM M 1980      55.00
MXM F 1980      60.00
...
MX   M41985
...
MX   F41985
...
MXM M 2050      80.00
MXM F 2050      85.00
*-----

```

These MXM records will produce life tables for 1980 and 2050 by the extrapolation method using the 1985 life tables and the patterns of change from the Coale-Demeny west region.

4.2.5 The DTH Record: Deaths by Age and Sex

The DTH record describes the data on deaths that follow. This record instructs the program to project the population using mortality data consistent with the input data on deaths. The program projects the population using the age-specific central death rates ($n\text{m}_x$) for the prior year and from the following life table (as defined by a MX, QX, or MLT record). For each age and sex group of input deaths, the surrounding $n\text{m}_x$ values are interpolated to obtain the number of deaths specified in the input.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
DTH s year      na      bsdth      mdth      fdth
SEP0      sep0m      sep0f
age wid      maled      femd
      or
age wid      bsexd
*-----
```

Record	Columns	Field	Definition
1	1-3	DTH	Indicates a <u>DTH</u> record.
	5	s	The sex of the death data by age: E or blank = each sex (male then female) B = both sexes
	7-10	year	Year to which the data refer.
	18-20	na	Number of age groups of death data (number of Data records). This number can vary from 0 (totals only) to the number of single years of age (up to 101). If na is 0, no data records follow this <u>DTH</u> record.
	21-30	bsdth	Total deaths for both sexes. If this record is entered, it takes precedence over the mdth and fdth data, as well as the data on deaths by age. In this case, the other death data will be proportionally adjusted to obtain this specified total.
	31-40	mdth	Total male deaths. If this is entered, it takes precedence over the data on deaths by age. If mdth + fdth is not equal to bsdth, then the bsdth total will be split by sex based on the ratio of mdth to fdth. The data by age for males will be proportionally adjusted to obtain the total male deaths (either mdth or (bsdth)x(mdth)/(mdth+fdth)).
	41-50	fdth	Total female deaths. See notes for mdth.

Record	Columns	Field	Definition
2	1-4	SEPO	Indicates this is a <u>SEPO</u> record. This record is optional, and should be included only if the user needs to enter the separation factor of infant deaths. This record, if present, must immediately follow the <u>DTH</u> record. If this record is not present, the separation factors will be estimated using the Coale and Demeny equations.
	11-20	<i>sep0m</i>	Separation factor of male infant deaths. The decimal point must be included.
	21-30	<i>sep0f</i>	Separation factor of female infant deaths. The decimal point must be included.
2 or 3	1-5	<i>age</i>	Lower limit of the age group.
	6-10	<i>wid</i>	Width of the age interval. Open-ended age groups should be coded with a width of 999.

If *s* = blank or E on the DTH record:

11-20	<i>maled</i>	Male deaths for this age group.
21-30	<i>femd</i>	Female deaths for this age group.

If *s* = B on the DTH record:

11-20	<i>bsexd</i>	Both sexes deaths for this age group.
-------	--------------	---------------------------------------

There should be a total of *na* records with death data by age.

When any adjustment is made to the input deaths based on the comparison of *bsdth*, *mdth*, *fdth*, and the data by age, a warning message is written to the input list file. The entry of different totals allows the user to enter reported deaths by age and sex, and adjusted total deaths (optionally by sex) based on analysis of the mortality data.

The age groups can be any width, and they do not need to be equal: some can be single years, some 5-year and/or 10 year groups. In addition, the open-ended age group can start at any age less than or equal to the open-ended age group used in the projection.

Example 1: Enter the number of infant and non-infant deaths

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
DTH B 1983      2      6000      3000      3000
0      1      2000
1 999      4000
*-----

```

The infant deaths are available only for both sexes combined.

Example 2: Enter only the total number of deaths

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
DTH E 1984      0      6100      3050      3050
*-----

```

The number of ages is entered as 0, and no death data records are entered.

Example 3: Enter data for mixed age groups

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
DTH E 1980      13
SEPO      .25
0      1      1000      900
1      1      100      90
2      1      50      45
3      1      25      22
4      1      10      9
5      5      40      36
10     5      35      32
15     5      40      36
20     10     90      81
30     10     200     180
40     10     300     270
50     10     400     360
60 999     2000     1800
*-----

```

Data for available age groups are entered without alteration. Since no totals are entered on the DTH record, the sum of the deaths by age will be used.

The number of deaths in the projection can be printed by including an ODTH record in the input file (see page 66).

4.3 Fertility Parameter Records

The ASFR, TFR, and BTH records are used to describe changes in fertility during the projection period.

4.3.1 The ASFR Record: Age-Specific Fertility Rates

The ASFR record and data records that follow specify age-specific fertility rates for a given year.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
ASFR ayear      ia
      asfr1      asfr2      asfr3      asfr4      asfr5 etc.
*-----
```

Record	Columns	Field	Definition
1	1-4	ASFR	Indicates that this is an <u>ASFR</u> record.
	6	a	Age grouping of the data: 0 or blank = default age grouping: 1 if <u>N</u> record provided 5 if <u>N5</u> record provided 1 = single years of age 5 = 5-year age groups
	7-10	year	Year to which the data refer.
	11-21	ia	Initial age of the fertility rates. If the <i>ia</i> field is 0 or blank, the default value of 15 will be used. Only values of 10 or 15 are acceptable if 5-year age groups are specified (a=5), and the value of <i>ia</i> can take on any value from 10 to 19 if single-year ASFRs are specified (a=1).

Record	Columns	Field	Definition
The age-specific fertility rates are coded in successive 10-column fields on records following the <u>ASFR</u> record. These rates should be expressed as births per woman in each age group, and the decimal point must be coded.			
2	1-10	<i>asfr1</i>	ASFR for first age group: 15-19 if <i>a</i> =5 and <i>ia</i> =0, blank, or 15 10-14 if <i>a</i> =5 and <i>ia</i> =10 15 if <i>a</i> =1 and <i>ia</i> =0, blank or 15 <i>ia</i> if <i>a</i> =1 and <i>ia</i> =10, 11, 12, ..., or 19
	11-20	<i>asfr2</i>	ASFR for second age group: 20-24 if <i>a</i> =5 and <i>ia</i> =0, blank, or 15 15-19 if <i>a</i> =5 and <i>ia</i> =10 16 if <i>a</i> =1 and <i>ia</i> =0, blank or 15 <i>ia</i> +1 if <i>a</i> =1 and <i>ia</i> =10, 11, 12, ..., or 19

	61-70	<i>asfr7</i>	ASFR for seventh age group: 45-49 if <i>a</i> =5 and <i>ia</i> =0, blank, or 15 40-44 if <i>a</i> =5 and <i>ia</i> =10 21 if <i>a</i> =1 and <i>ia</i> =0, blank or 15 <i>ia</i> +6 if <i>a</i> =1 and <i>ia</i> =10, 11, 12, ..., or 19
	71-80	<i>asfr8</i>	ASFR for eighth age group: blank if <i>a</i> =5 and <i>ia</i> =0, blank, or 15 45-49 if <i>a</i> =5 and <i>ia</i> =10 22 if <i>a</i> =1 and <i>ia</i> =0, blank or 15 <i>ia</i> +7 if <i>a</i> =1 and <i>ia</i> =10, 11, 12, ..., or 19

If *a*=1 (single years of age), additional records must be included to enter the ASFRs up to and including age 49.

Example 1: Enter ASFRs for the default 5-year age groups

*	10	20	30	40	50	60	70	80
*								
ASFR 51950								
	0.1107	0.2583	0.3440	0.2706	0.1722	0.0615	0.0123	

Example 2: Enter ASFRs for single years of age

*	10	20	30	40	50	60	70	80
*								
ASFR 11989		14						
	0.0001	0.0005	0.0023	0.0086	0.0249	0.0522	0.1137	0.1687
	0.2205	0.2753	0.2945	0.2947	0.2624	0.2113	0.1675	0.1298
	0.1011	0.0796	0.0630	0.0537	0.0429	0.0335	0.0331	0.0250
	0.0222	0.0231	0.0155	0.0105	0.0107	0.0071	0.0068	0.0036
	0.0012	0.0010	0.0006	0.0003				

ASFRs are entered by single years of age. Since *ia*=14, the first ASFR is for age 14. The last ASFR (0.0003) is for women aged 49.

4.3.2 The TFR Record: Total Fertility Rates

The TFR record is used to specify the desired total fertility rate for the year coded in columns 7 to 10. The TFR record tells the program to either:

- (1) Interpolate between surrounding ASFRs to obtain a set of ASFRs that corresponds to a $TFR=tfr$, or
- (2) Proportionally adjust the nearest set of ASFRs to obtain a $TFR=tfr$.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
TFR  year      tfr
*-----
```

Record	Columns	Field	Definition
1	1-4	TFR	Indicates this is a <u>TFR</u> record.
	7-10	year	Year to which the data refer.
	11-20	tfr	The desired total fertility rate for this year. The decimal point must be included.

When using the TFR record to interpolate between sets of ASFRs, exercise caution if the ASFR for any age is changing in the opposite direction from the TFR (e.g., the TFR is decreasing, but the ASFR for ages 25-29 is increasing) and/or the difference between TFR values for the surrounding ASFRs is very small. In either of these situations, the program will display a warning message. If the specified TFR value is outside the range of TFR values for the surrounding sets of ASFRs, individual interpolated ASFR values can take on unlikely values. If this occurs, you should estimate a set of ASFRs for the intermediate year (perhaps by taking an average of the surrounding ASFRs and adjusting to the desired TFR).

In contrast to other projection parameter records, a TFR record for the same year can follow an ASFR record and ASFR data. In this case, the ASFR data are proportionally adjusted to the value *tfr* as specified on the TFR record.

Example 1: Use the same ASFR pattern

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
TFR  1975      6.50
ASFR 51980
      0.1107    0.2583    0.3440    0.2706    0.1722    0.0615    0.0123
TFR  1985      5.50
*-----
```

If these are the only fertility inputs, the program will proportionally adjust the input ASFRs for 1980 to a TFR of 6.5 for 1975 and 5.5 for 1985.

Example 2: Interpolate between sets of ASFRs

*	10	20	30	40	50	60	70	80
*								
ASFR 51950								
	0.1107	0.2583	0.3440	0.2706	0.1722	0.0615	0.0123	
TFR 1980		4.00						
ASFR 52000								
	0.02	0.08	0.10	0.10	0.07	0.02	0.01	
*								

The ASFRs for 1980 will be determined by interpolating between the ASFRs for 1950 and 2000, using the TFR values to compute the interpolation coefficients (see part G, section 2, pages 73-74).

Example 3: Adjust ASFRs for a single year

*	10	20	30	40	50	60	70	80
*								
ASFR 51980								
	0.1107	0.2583	0.3440	0.2706	0.1722	0.0615	0.0123	
TFR 1980		5.50						
*								

The program will proportionally adjust the input ASFRs for 1980 to a TFR of 5.50.

4.3.3 The BTH Record: Births by Age of Mother

The BTH record is used to input data on births. The birth data can include totals by sex, and births by age.

*-----								
*	10	20	30	40	50	60	70	80
*----- ----- ----- ----- ----- ----- ----- -----								
BTH	year	na	bsbth	mbth	fbth			
age	wid	bsexb						
*-----								

Record	Columns	Field	Definition					

1	1-4	BTH	Indicates the <u>BTH</u> record.					
	7-10	year	Year to which the data refer.					
	11-20	na	Number of age groups, which is the number of data records that follow. This can range from 0 (totals only) to the number of single years of age (40, ages 10 to 49). If na=0, then no data records are expected.					
	21-30	bsbth	Total births for both sexes. If this item is entered, it takes precedence over the mbth and fbth data and the data on births by age. The other birth data will be proportionally adjusted to obtain this total.					
	31-40	mbth	Total male births.					
	41-50	fbth	Total female births.					
2	1-5	age	Lower limit of the age group. This can vary from 10 to 49.					
	6-10	wid	Width of the interval. This can vary from 1 to 40.					
	11-20	bsexb	Births for both sexes for this age group.					

The total births by sex on the BTH record can be used to make adjustments to the data. The program will compare the total births for both sexes (*bsbth*) to the sum of the male and female births (*mbth* + *fbth*). If they are not the same, the male and female births will be proportionally adjusted. Similarly, the total births on the BTH record will be compared to the sum of the age data given, and the data by age will be proportionally adjusted if the sum differs from the desired total. When any adjustment is made to the input births, a warning message is written to the input list file. This feature allows you to enter reported births by age and adjusted total births based on analysis of the fertility data.

Example 1: Enter births for 5-year age groups of women

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
BTH    7      20500    10500    10000
15     5      2000
20     5      5000
25     5      6000
30     5      4000
35     5      2000
40     5      1000
45     5      500
*-----

```

The totals all agree, so there would be no adjustment of the data.

Example 2: Enter births for selected single years of age

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
BTH    11      30000    105      100
15     1      0
16     1      100
17     1      400
18     1      600
19     1      900
20     5      5000
25     5      6000
30     5      4000
35     5      2000
40     5      1000
45     5      500
*-----

```

The births for ages 15 to 19 are given by single years. In addition, the total for both sexes is different from the sum of the male and female totals, so the male and female totals will be proportionally adjusted to sum to 30,000. Similarly, since the sum of the births by age differs from the total for both sexes, the births by age will be proportionally adjusted to the total of 30,000 for both sexes.

4.4 International Migration Parameter Records

The MIGN and MIGR records are used to define the nature of international migration during the projection period. Currently all international migration inputs for a particular area must be either rates (MIGR) or numbers (MIGN).

4.4.1 The MIGN Record: Net Number of International Migrants

The MIGN record initiates the input of net numbers of international migrants for the specified sex, age grouping, and year.

```
*-----*
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
MIGNsayear      na
      migs1      migs2      migs3      migs4      migs5      etc.
*-----*
```

Record	Columns	Field	Definition
1	1-4	MIGN	Indicates this is a <u>MIGN</u> record.
	5	s	The sex of the population data: M = Male F = Female E or blank = Each sex (male then female)
	6	a	Age grouping of the data: 0 or blank = default age grouping: 1 if <u>N</u> record provided 5 if <u>N5</u> record provided 1 = Single years of age 5 = Ages 0-4, 5-9, etc. 9 = All ages. If this code is selected, then there must be at least one other <u>MIGN</u> record followed by migration data by age and sex.
	7-10	year	Year to which the data refer.
	11-20	na	Number of age groups of input. If this is blank or 0, the number of ages will default to the number of single years of age (if a=1) or the number of 5-year age groups (if a=5). Enter a value here only if you are entering supplementary single year data (single year data for the youngest ages) or if the data contain more age groups than the number specified on the <u>N5</u> or <u>N</u> record. If more age groups are specified, the data for the older ages will be aggregated to the open-ended age group to be used in the projection.

Record	Columns	Field	Definition
<p>The net numbers of migrants are coded in successive 10-column fields on data records following the <u>MIGN</u> record. The numbers should be right-justified or include the decimal point. Positive values indicate net international migration into the particular area (i.e., total country, urban, or rural) while negative values indicate movement from the area or out of the country.</p>			
2	1-10	<i>migs1</i>	Net number of migrants for the first age group.
	11-20	<i>migs2</i>	Net number of migrants for the second age group.
	21-30	<i>migs3</i>	Net number of migrants for the third age group.

	71-80	<i>migs8</i>	Net number of migrants for the eighth age group.

When migrant totals are given ($a=9$), the program will interpolate the age pattern of migrants (the percent distribution for each sex) for the nearest prior and following years (if available) based on the years, then redistribute using the total migrants for the sex indicated. If the totals by sex precede the first age/sex data (or follow the last age/sex data), then the program will use the same pattern as for the nearest age/sex distribution. Since the percent distribution by age is used, the interpretation of the results is questionable if the age/sex data on migrants contain both positive and negative figures, and especially when the sign of the given total is the opposite of the total(s) for the age distribution(s) used to distribute the given total.

If the total net number of migrants is zero for an age distribution of migrants needed for interpolation for a year where totals by sex are provided, then the program will print out an error message and stop since it cannot create a percent distribution if the total is zero. Zero totals can be specified for either or both sexes, which will result in zero migrants at all ages.

Example 1: Enter data for net in and out migration

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
MIGNM51950
      349      456      798      2256      3521      2392      1563      953
      622      253      103      -20      -32      -41      -21      -5
      -2
*-----

```

Net immigration is entered for ages under 55, and net emigration for ages 55 and over.

Example 2: Enter a fixed pattern of migrants, with changing levels

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
MIGNM51980
      900      900      900      2000      3000      3000      2000      1000
       0       0       0       0       0       0       0       0
       0
...
MIGNM91985
      10000
...
MIGNM92000
       0
*-----

```

There is a net in-migration of 13,700 males into the area in 1980. This drops to 10,000 in 1985 and to 0 by the year 2000. All of the migrants are under the age of 40.

4.4.2 The MIGR Record: Age-Sex-Specific International Net Migration Rates

The MIGR record specifies the input of age-sex-specific net international migration rates.

```

*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
MIGRsayear      na
      migr1      migr2      migr3      migr4      migr5      etc.
*-----

```

Record	Columns	Field	Definition
1	1-4	MIGR	Indicates this is a <u>MIGR</u> record.
	5	s	The sex of the population data: M = Male F = Female E or blank = Each sex (male then female)
	6	a	Age grouping of the data: 0 or blank = default age grouping: 1 if N record present 5 if <u>N5</u> record present 1 = Single years of age 5 = Ages 0-4, 5-9, etc.
	7-10	year	Year to which the data refer.
	11-20	na	Number of ages of input. If this is blank or 0, the number of ages will default to the number of single years of age (if a=1) or the number of 5-year age groups (if a=5). Enter a value here only if you are entering supplementary single year data (single year data for the youngest ages).

Record	Columns	Field	Definition
The rates are specified in successive 10-column fields on records following the <u>MIGR</u> record. They are expressed as the net number of migrants per person, and the decimal point must be coded.			
2	1-10	<i>migr1</i>	Migration rate for first age group: 0 (under 1) if a=1 0-4 if a=5
	11-20	<i>migr2</i>	Migration rate for second age group: 1 if a=1 5-9 if a=5
	21-30	<i>migr3</i>	Migration rate for third age group: 2 if a=1 10-14 if a=5

	71-80	<i>migr8</i>	Migration rate for eighth age group: 7 if a=1 35-39 if a=5

Example: Enter data for net in and out migration

*	10	20	30	40	50	60	70	80
*								
MIGRM51950	17							
	-0.001	-0.002	-0.003	-0.004	-0.005	-0.005	-0.005	-0.004
	-0.003	-0.002	-0.001	0.000	0.001	0.002	0.003	0.002
	0.001							
*-----								

Men under age 55 are leaving the area, but men ages 60 and over are entering the area.

4.5 The RUMN and RUMR Records: Internal (Rural/Urban) Migration

The RUMN and RUMR records indicate the input of net internal (usually rural-to-urban or urban-to-rural) migrant numbers and migration rates, respectively. These records are valid inputs only for the first phase defined by an AREA record in the projection (usually the rural population projection in phase 1). If phase 1 is the total country projection (contains a TOT record), then the RUMN or RUMR records must be in phase 2. If rates are used, be sure that the base of the rates is the same as the area of the projection and that the sign is correct (if the migrants are leaving the area, the values should be negative). The program will print a warning message in the listing log if an AREA record is present but no internal migration data (RUMN or RUMR records) are found.

The RUMN and RUMR records are coded the same as the MIGN and MIGR records, respectively.

```

*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
RUMNsyear      na
migs1      migs2      migs3      migs4      migs5      etc.
*
RUMRsyear      na
migr1      migr2      migr3      migr4      migr5      etc.
*-----

```

Example 1: Enter internal migration rates

```

*-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
...
AREA
RURAL
...
RUMRM51950
0.0      -0.001      -0.002      -0.003      -0.004      -0.005      -0.004      -0.003
-0.002      -0.001      0.0      0.001      0.002      0.003      0.002      0.001
0.0
RUMRF51950
0.0      -0.001      -0.002      0.001      0.001      0.0      0.0
0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
0.0
*-----

```

Children 5-9 and 10-14 and men 15 to 49 are leaving the rural area, while women 15 to 24 and men 55 to 79 are moving into the rural area.

5. Output Specifications

The following records are used to specify the desired output. If no output records are specified, the full-page output is produced for every year of the projection. The specified outputs are sent to disk files which can be selectively printed using the RUPEX interface.

The output specification records are cumulative: those specified during phase 2 (usually the urban phase) are added to those previously specified in the first phase. However, the specifications for a particular *type/s/a/dsrn* combination must be entered in chronological order.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|
OUTPsayear      frq      yfr      dsrn
OPOPsayear      frq      yfr      dsrn
OMX sayear      frq      yfr      dsrn
ODTHsayear      frq      yfr      dsrn
OBTHsayear      frq      yfr      dsrn
*-----
```

Record	Columns	Field	Definition
1	1-4	type	<u>OUTP</u> = detailed output <u>OPOP</u> = population output <u>OMX</u> = $n m_x$ or life table output <u>ODTH</u> = output of deaths by age and sex <u>OBTH</u> = output of births by age of mother
	5	s	The sex of the population data: M = Male F = Female E or blank = Each sex (male then female)
	6	a	Age grouping of the data: 0 or blank = default age grouping: 1 if <u>N</u> record present 5 if <u>N5</u> record present 1 = Single years of age 4 = Ages 0 (under 1), 1-4, 5-9, etc. 5 = Ages 0-4, 5-9, etc.
	7-10	year	Initial year of desired output. This year does not have to be within the projection period. A blank year specifies the base year of the projection.

Record	Columns	Field	Definition
	11-20	<i>frq</i>	Frequency with which the particular data are to be written out. For example, enter code 5 if you want the data written out every 5 years, starting with the year specified in the <i>year</i> field. Blank, 0, or code 1 specify output for every year.
	21-30	<i>yrf</i>	Final year that this output operation is to be performed. Specify the same year in the <i>yrf</i> and <i>year</i> fields to indicate that this output is desired for only that year. If you enter <i>yrf</i> as blank or equal to 0, the output will be produced until the end of the projection or until another output specification record with the same <i>type/s/a/dsrn</i> combination is encountered. If you enter another output specification record with the same <i>type/s/a/dsrn</i> combination, the earlier specification will remain in effect only until the year specified on the second record is reached.
	31-40	<i>dsrn</i>	<p>Data set reference number for an alternate file for the particular output. Data set reference numbers are arbitrary symbols used in the program to refer to a particular input or output device (e.g., keyboard, printer, disk file). In this case the value of <i>dsrn</i> will be associated with a particular disk file.</p> <p>-Usually, you will leave this field blank, and the output will be sent to the default file for later printing.</p> <p>-If you enter a non-zero value for <i>dsrn</i>, the output is generally produced in a format similar to the input to RUP and can in fact be used as input to other RUP runs. This means that the actual data are preceded by a parameter record which indicates the type of data that follows, including the age-grouping, sex, and year.</p> <p>-The program will check to be sure that the value specified for <i>dsrn</i> is not the same as any of the pre-assigned values used by the program (see Table 4, page 65).</p> <p>-If you give a non-zero value for <i>dsrn</i>, the program will generate a filename for the file created (see Table 5, page 65).</p>

Table 4. Data Set Reference Numbers (DSRN's) Used by RUP

DSRN	File associated with that DSRN
1	Input file
2	Intermediate file, phase 1
3	Intermediate file, phase 2
4	Miscellaneous output file
6	Summary Table 1
7	Summary Table 2
8	Listing file
15	Full-page output

If you enter a data set reference number (*dsrn*) on an output specification record, the program will ask for a data set name to be associated with that *dsrn* value. If you leave it blank or set it to 0, the output will be added to the end of the full-page output file.

Table 5. Types of Output

Table	Output record	Location	Filename
(input file)	not applicable	Input file	input.in
Input listing	always generated	Input listing	input.out
Summary Table 1	always generated	Summary Table 1	input1.out
Summary Table 2	always generated	Summary Table 2	input2.out
Population by age and sex	OUTP	Full-page	inputF.out
Vital rates	OUTP	Full-page	inputF.out
Migration data	OUTP	Full-page	inputF.out
Population by single ages	OPOP	Full-page	inputF.out
	OPOP *	Population	inputP.out
Mx values/life tables	OMX	Full-page	inputF.out
	OMX *	Mx values	inputM.out
Deaths by age and sex	ODTH	Full-page	inputF.out
	ODTH *	Deaths	inputD.out
Births by age of mother	OBTH *	Births	inputB.out

* Output generated when *dsrn* is specified.

Table = Type of data or table.

Output record = Output record type needed in input file to get this data.

Location = Title of output file.

Filename = Default name of file where output will be stored.

5.1 The OUTF Record: Detailed Population, Vital Rates, and Migration Data

The OUTF record indicates the frequency with which the detailed results should be printed. These detailed results usually consist of 3 pages per year (see pages 11-13 for examples): (1) population data by 5-year age groups, (2) vital rates, and (3) migration data by age and sex. The detailed results are the basic components of the full-page output.

Insert an OUTF record with no parameters to reset the program to the default output options to produce detailed output for every year. For example, to change all output options in phase 2 or 3, insert an OUTF record with no parameters followed by the desired output specification records. However, this default output will not be produced if you include any other output specification records. If you want other output specifications in phases 2 or 3, insert the OUTF record with no options first, followed by an OUTF record with the desired options (including at least one value on the record) and then the other output specification records.

5.2 The OPOP Record: Population Data

The output of the population by age and sex is indicated by the OPOP record. If the *dsrn* field is 0 or blank on the OPOP record, there will be no additional output if 5 is coded in the *a* field. This is because the presentation of the population by 5-year age groups is part of the output generated by the OUTF record. However, special tables of population by single years of age will be generated (at the end of the run) if *dsrn* is 0 or blank and *a* = 1. See page 15 for an example of this single-year output.

5.3 The OMX Record: Age-Sex-Specific Central Death Rate or Life Table Data

The OMX record is used to output the age-sex-specific central death rates. Due to possible rounding differences, it is possible to produce this output only for the default age grouping for mortality, which is *a* = 4 unless there is at least one single-year mortality input during the current phase. If *dsrn* is 0 or blank, then the life table for the specified sex, age grouping and year will be printed at the end of the projection. See page 14 for an example of a life table printout.

5.4 The ODTN Record: Deaths by Age and Sex

The ODTN record is used to produce data on deaths by age and sex. These data are useful when data on deaths by age are provided as input on the DTN record. If no *dsrn* is included, the table of deaths by age and sex will be part of the full-page output file. See page 16 for an example of output of deaths by age

5.5 The OBTH Record: Births by Age of Mother

The OBTH record is used to obtain output of births by age of mother. This output can be useful for comparing the results of the projection to registration data. Since the births by 5-year age group of mother are produced as part of the detailed output file (determined by the OUTF record), the output will be produced only if the *dsrn* field is non-zero, which will send the output to a separate file.

5.6 Examples of Output Parameter Records

Example 1: Request population by single years of age

```

-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
OPOP 11950      5
OPOP 11970      20      2050
OPOP 12025      2025
-----

```

Population by sex and single years of age will be printed for the years 1950, 1955, 1960, 1965, 1970, 1990, 2010, and 2025.

Example 2: Changing output options

```

-----
*      10      20      30      40      50      60      70      80
*      |      |      |      |      |      |      |      |
...
AREA
RURAL
...
OUTP 1955
OMX 1960      5
END
AREA
URBAN
...
OPOP 11950
TOT
...
OUTP
OUTP 1950      5
OMX 1950      10
ODTH 1980      1990
OPOP 11990      5      2000      9
END
-----

```

Detailed output will be produced for every year starting in 1955 for the rural area, and life tables will be printed for every fifth year starting in 1960. These items will also be printed for the urban area with the addition of population by single years of age starting in 1950.

The `OUTP` record with no other fields entered erases the previous print specification, so the output for the total country will consist of:

- (1) Full-page output for every fifth year starting in 1950
- (2) Life tables for every tenth year starting in 1960
- (3) Deaths by age and sex for every year from 1980 to 1990
- (4) Population by single years of age for 1990, 1995, and 2000 sent to a separate file (`dsrn=9`).

6. The END Record: End of Projection Inputs

The END record signals the end of the current projection.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|-----|
END
*-----
```

7. The NOTE Record and * (Comment) Records

The NOTE record informs the program that the *nn* records which follow are to be printed in the input data log. This allows you to annotate the sources of data or make comments about the data.

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|-----|
NOTE      nn
notes ...
*-----|-----|-----|-----|-----|-----|-----|-----|
* comment
*-----
```

Alternatively, you may use the comment line. It is a more convenient method for annotating the input file because each comment line can be entered directly without counting the number of lines. Each comment line begins with an asterisk in column 1, and the comments are contained in columns 2-80. You can place a comment line anywhere a parameter record is expected.

8. The EDIT Record: Record Scan Without Projection

The EDIT record can be used to verify that the parameter records for a RUP run are correct. The EDIT record must be the first record in the run if you select this feature. The parameter records and data records will be scanned, and any errors detected will be indicated in the output. This is particularly useful for detecting input format errors in the second phase of the projection without waiting for the computer to perform the projection of the first area. The EDIT scan cannot detect certain errors which may occur during a projection (e.g., dividing by 0).

```
*-----
*      10      20      30      40      50      60      70      80
*-----|-----|-----|-----|-----|-----|-----|-----|
EDIT
*-----
```

G. Methods Used by the RUP Program

1. Projection Method

The RUP program projects populations forward one year at a time using calendar-year events. Thus, it uses single year (calendar year) age-specific death rates rather than survival ratios to project a midyear population to the next year. This assumes that the number of deaths from time t to $t+1$ to the cohort of people aged x at their last birthday at time t (parallelogram A in Figure 1) is equal to one-half the sum of the deaths to people aged x at their last birthday during the year centered on t (square B in Figure 2) and those to people aged $x+1$ at their last birthday during the year centered on $t+1$ (square C in Figure 2). If migration is a component in a run of the projection, deaths to the cohort migrants are calculated in a similar manner.

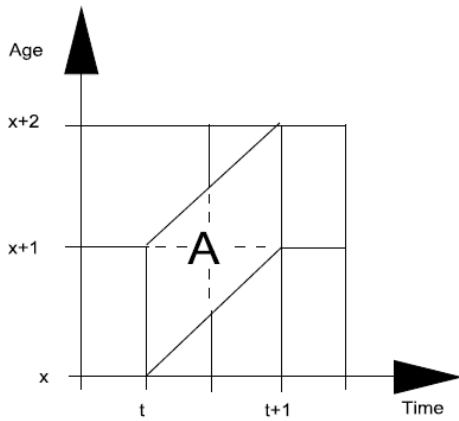


Figure 1. Projected Cohort Events

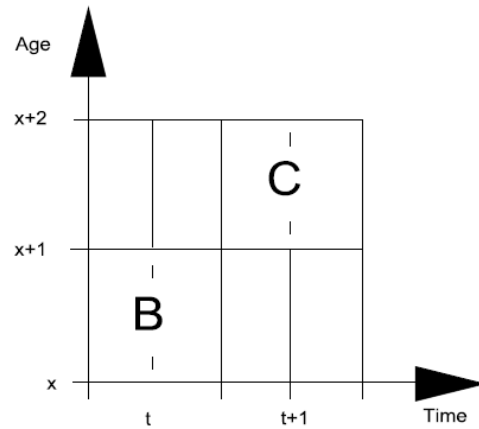


Figure 2. Calendar Year Events

In a projection program, the values of all variables are known for year t , while only the age-sex-specific death rates, age-specific fertility rates, and either the age-sex-specific net migration rates or number of net migrants by age and sex are known for year $t+1$ (i.e., they are specified as input to the program). In the discussion above, the number of deaths to the population aged $x+1$ at their last birthday in the year centered on $t+1$ is unknown (square C in Figure 2). Those deaths are equal to the mortality rate for age $x+1$ (which is known) times the population aged $x+1$ at time $t+1$ (which is not known). A similar situation exists with respect to the number of migrants aged $x+1$ at time $t+1$, if the input data are in the form of migration rates.

The projection is accomplished through a system of three equations with three unknowns (the population, deaths, and migrants aged $x+1$ in year $t+1$).

Definitions:

$P_x(t)$ = population aged x , last birthday, at time t .

$N_x(t)$ = net migrants aged x , last birthday, migrating during the year centered on t .

$D_x(t)$ = deaths aged x , last birthday, dying during the year centered on t .

$n_x(t)$ = net migration rate for persons aged x , last birthday, during the year centered on t .

$m_x(t)$ = central death rate for persons aged x , last birthday, during the year centered on t .

Equations:

$$(1) \quad P_{x+1}(t+1) = P_x(t) - 0.5D_x(t) + 0.5N_x(t) - 0.5D_{x+1}(t+1) + 0.5N_{x+1}(t+1)$$

$$(2) \quad D_{x+1}(t+1) = P_{x+1}(t+1) m_{x+1}(t+1)$$

$$(3) \quad N_{x+1}(t+1) = P_{x+1}(t+1) n_{x+1}(t+1)$$

Substituting equations (2) and (3) into equation (1) and solving for $P_{x+1}(t+1)$ we get:

$$(4) \quad P_{x+1}(t+1) = \frac{P_x(t) - 0.5D_x(t) + 0.5N_x(t)}{1 + 0.5m_{x+1}(t+1) - 0.5n_{x+1}(t+1)}$$

The number of deaths and migrants in year $t+1$ can then be computed using equations (2) and (3), after which the population for year $t+2$ can be determined in a similar manner.

When the migration data are in the form of absolute numbers rather than rates, then equation 3 is unnecessary and the final result is:

$$(5) \quad P_{x+1}(t+1) = \frac{P_x(t) - 0.5D_x(t) + 0.5N_x(t) + 0.5N_{x+1}(t+1)}{1 + 0.5m_{x+1}(t+1)}$$

Since it is assumed that the input migration data are all in the form of age-sex-specific rates or, alternatively, absolute numbers of migrants by age and sex, equations (4) and (5) can be combined by defining a variable, g , which indicates the format of the input migration. Thus, ipg is set equal to zero when the input migration data are in the form of absolute numbers of migrants, or ipg is set equal to 1 if the input migration data are in the form of rates:

$$(6) \quad P_{x+1}(t+1) = \frac{P_x(t) - 0.5D_x(t) + 0.5N_x(t) + 0.5N_{x+1}(t+1)(1-g)}{1 + 0.5m_{x+1}(t+1) - 0.5n_{x+1}(t+1)g}$$

When both internal and international migration are used, equation (6) is expanded to include 2 forms of migration (say N and N') with corresponding migration type indicators, g and g' .

As illustrated in Figure 3, the same reasoning underlies the projection of the population in the last age group (where age z is the lower limit of the open-ended age group):

$$(7) \quad P_z(t+1) = \frac{P_{z-1}(t) - 0.5D_{z-1}(t) + 0.5N_{z-1}(t) + P_z(t) - 0.5D_z(t) + 0.5N_z(t) + 0.5N_z(t+1)(1-g)}{1 + 0.5m_z(t+1) - 0.5n_z(t+1)g}$$

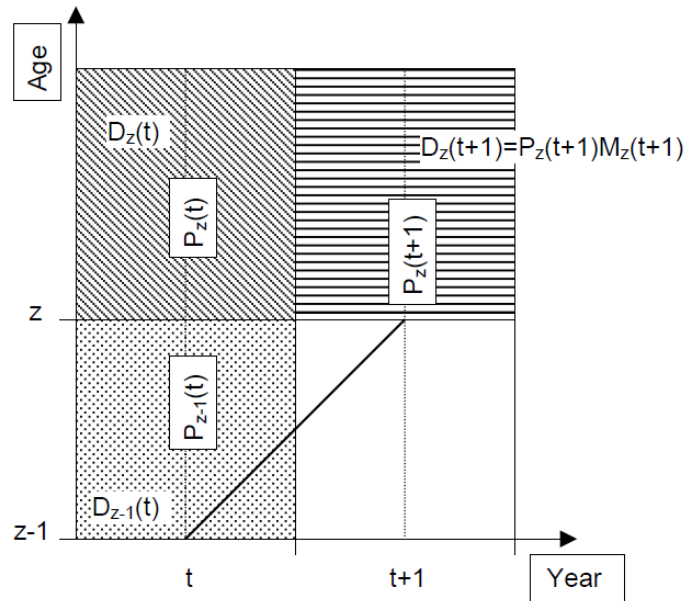


Figure 3. Projection of the Open-ended Age Group

The first two age groups also require special equations in order to take into consideration the separation factor of infant deaths, k (see Figure 4).

$$(8) \quad P_0(t+1) = \frac{0.5[B(t) + B(t+1) - D_0(t)(1 - k(t)) + N_0(t+1)(1-g)]}{1 + 0.5m_0(t+1)(1-k(t+1)) - 0.5n_0(t+1)g}$$

where:

$B(t)$ = births in the year centered on t .

$$(9) \quad P_1(t+1) = \frac{P_0(t) - 0.5D_0(t)k(t) - 0.5D_0(t+1)k(t+1) + 0.5N_0(t) + 0.5N_1(t+1)(1-g)}{1 + 0.5m_1(t+1) - 0.5n_1(t+1)g}$$

The births $B(t+1)$ for the projection year must be determined before equations (8) and (9) can be used. This is done based on the age-specific fertility rates, $f_x(t+1)$, in year $t+1$ for women aged x :

$$(10) \quad B(t+1) = \sum_{x=15}^{49} f_x(t+1) P_x(t+1)$$

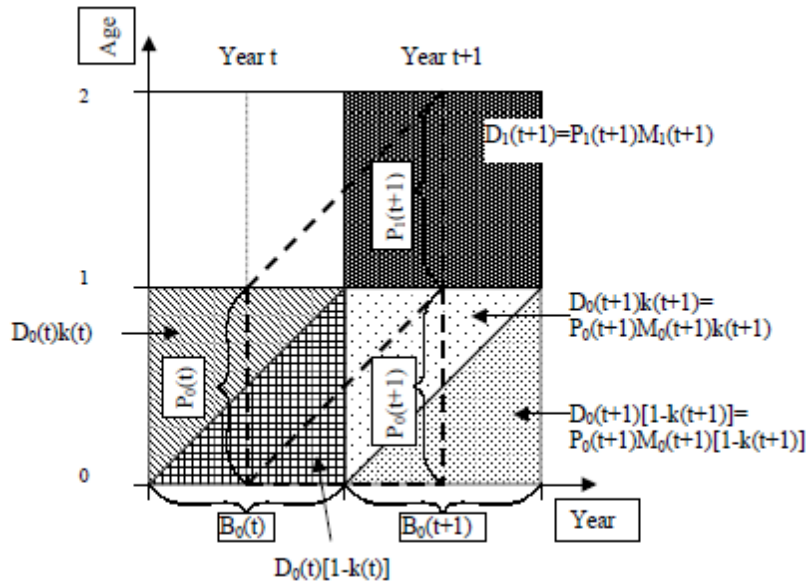


Figure 4. Projection of the Population from Birth to Age 1

2. Interpolation

The values of age-sex-specific data (central death rates, migration rates, or fertility rates) for years not given as input are determined by the following rules. In general, values are linearly interpolated between input values, and values before the first input value and values after the last input value are held constant at the level of the nearest input value.

Thus, if x_1, x_2, \dots, x_n are the input values for the years t_1, t_2, \dots, t_n , then the value x for the year t is determined as follows:

$$\begin{aligned} x &= x_1 && \text{if } t \leq t_1 \\ x &= (1-w)x_i + wx_{i+1} && \text{if } t_i \leq t \leq t_{i+1} \\ &\text{where } w = (t - t_i) / (t_{i+1} - t_i) \\ x &= x_n && \text{if } t \geq t_n \end{aligned}$$

Figure 5 illustrates this in a case where there are three input values $x_1=5$, $x_2=25$, and $x_3=30$, which correspond to years t_1 , t_2 , and t_3 , respectively. The value for t shown (half way between t_1 and t_2) would be interpolated to 15 in this case. For years before t_1 , the value would be $x_1=5$ while for years after t_3 , the value would be $x_3=30$.

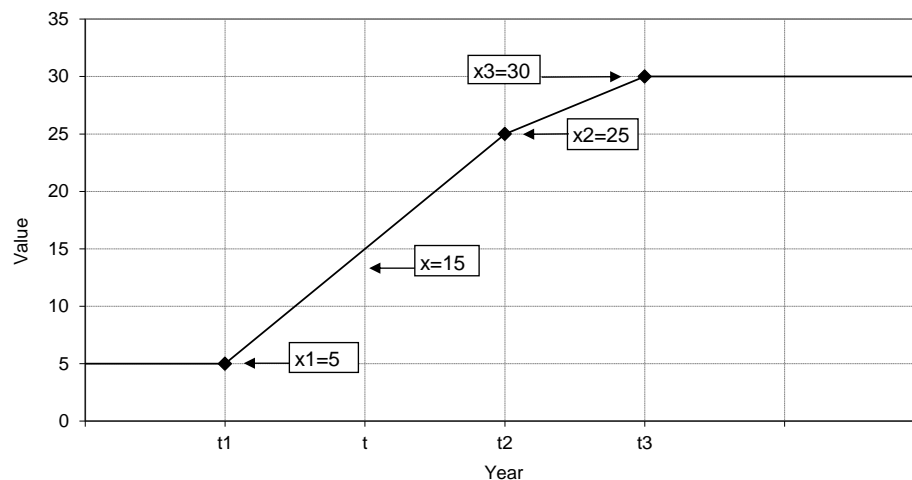


Figure 5. Interpolation Procedure

The age-specific fertility rates for years between successive ASFR record inputs are computed by linear interpolation:

$$(1) \quad w = (t - t_1) / (t_2 - t_1)$$

$$(2) \quad f_x(t) = (1 - w)f_x(t_1) + (w)f_x(t_2)$$

where:

x = age of mother

f_x = ASFR for women age x

t_1 = year of previous input ASFR

t_2 = year of following input ASFR

t = year desired

When a TFR record is included between two ASFR records, the age-specific fertility rates for the year specified on the TFR record, t , are computed by linear interpolation between the input ASFRs for the nearest preceding and following years using equation (2) above. The weight, w , is computed as:

$$(3) \quad w = [TFR(t) - TFR(t_1)] / [TFR(t_2) - TFR(t_1)]$$

For the years between TFR inputs or between ASFR and TFR input, the procedure requires 2 steps. First, the TFR for year t is found by linear interpolation between surrounding input TFR values:

$$(4) \quad w' = (t - t') / (t'' - t')$$

where:

t' = year of previous ASFR or TFR record

t'' = year of following ASFR or TFR record

$$(5) \quad TFR(t) = (1 - w')TFR(t') + w'TFR(t'')$$

Then the ASFRs are found using equations (3) and (2) above, as if a TFR record with the value $TFR(t)$ were included.

If a TFR record precedes the first ASFR record (and associated age-specific fertility rates) or follows the last ASFR record, the pattern of fertility from the nearest ASFR specification is used and adjusted to the total fertility rate specified on the TFR record. Between the year of the TFR record and the ASFR record, the TFR values are linearly interpolated as in equation (4) but the ASFR pattern is the same as that specified on the data records following the ASFR record.

3. Rounding

In order to preserve consistency among different values printed by the program, certain values are rounded progressively. Progressive rounding is a procedure used to round a set of ordered numbers which preserves the rounded total. The progressively rounded values, $r(i)$, of a series of values, $x(i)$, are defined as follows:

$x(i)$ = i th value to be rounded

$$X(i) = \sum_{j=1}^i x(j)$$

where $X(0)$ is defined as equal to zero.

$R[X(i)]$ = the value of $X(i)$ rounded to the nearest integer

$r(i) = R[X(i)] - R[X(i-1)]$ = i th progressively rounded value

In most cases, progressive rounding results in the same integer values as individual rounding. However, it often happens that individual rounding results in a set of values that do not sum to the rounded value of the unrounded sum. There are cases where progressive rounding rounds differently, but the difference between the rounded and unrounded values is never greater than 1.0.

In addition to reproducing the rounded total, progressive rounding also reproduces the sum of subsequences which have integral values. Thus, in the case of population data, if integral population figures in 5-year age groups have been subdivided into single-year data based on a mathematical formula (such as the BEERS procedure), progressive rounding provides a way to obtain integral single-year population figures that sum to the input 5-year age group figures.

Progressive rounding is used to obtain integral values of population, deaths, and migrants by single years of age for each sex, and births by single years of age of the mother.

The age-specific fertility rates, infant mortality rates, expectations of life at birth, and migration rates printed by the program for subareas are based on the input or on interpolated values. The values for the total country, however, are based on the rounded populations, births, deaths, and migrants by single years of age. The subarea (usually the urban or rural area) values, thus, represent the values (or functions of the values) used to perform the projection, while for the total country the values are an 'actualization' of those rates in terms of integral values. This means, for example, that the life table, computed based on rounded deaths and populations, may not result in the same expectation of life at birth as that printed for a subarea, although the difference should be minimal except in small populations.

In most cases, the impact of such rounding will not be observed. However, if

the same life table or ASFRs are used in both areas, it is possible that the values printed for the total country will differ from the values used for the subareas.

4. Mortality

a. Splitting Data into Single Years of Age

(1) Ages 5 and over

For ages 5 and over, input central death rates for 5-year age groups (${}_5M_x$ values) are split into single year rates (${}_1M_x, {}_1M_{x+1}, \dots, {}_1M_{x+4}$) by assuming all the single-year rates are equal to the rate for the 5-year age group. This method has the advantage of simplicity and also ensures that the deaths in each 5-year age group will be the same when using the single-year data as when using the 5-year data.

(2) Ages 1 to 4 years

Mortality in the age group 1 to 4 years changes more rapidly than at most ages over 5 years, so RUP always treats these ages in a different manner. There are 5 ways that the single-year central death rates for ages 1 to 4 years can be determined: (a) specify the single-year rates directly; (b) use the Coale-Demeny separation factors; (c) specify a particular separation factor; (d) specify a separation factor of 2.0, representing equal rates; or (e) specify the adjustment (*adj*) option. Each of these options is discussed below.

(a) If the single-year age-specific central death rates (or mortality rates) are provided as input, these values are used without modification for that year.

(b) When no separation factor is specified, the Coale-Demeny separation factors are used. These values are determined as a function of the infant mortality rate using the formula:

$$k = \begin{cases} a & \text{if } q_0 \leq 0.100 \\ b + cq_0 & \text{if } q_0 \geq 0.100 \end{cases}$$

where the values of a , b , and c are functions of region and sex:

Parameter	Region	Male	Female
a	West	1.352	1.361
	North	1.558	1.570
	East	1.313	1.324
	South	1.240	1.239
b	West	1.653	1.524
	North	1.859	1.733
	East	1.541	1.402
	South	1.614	1.487
c	All	3.013	1.627

(c) If a separation factor is specified, the program uses the Coale-Demeny separation factors as an initial try for splitting the mortality into single years, then modifies them to obtain the specified separation factor. Thus, a set of interpolation factors g'_2 , g'_3 , and g'_4 is determined based on the Coale-Demeny equations shown above and the empirical q_0 value. These interpolation factors imply a separation factor k'_1 where:

$$k'_1 = 0.5 + g'_2 + g'_3 + g'_4$$

These values of g'_i are then adjusted to obtain the desired separation factor k_1 :

$$d = k_1 - k'_1$$

$$g_i = g'_i + d/3$$

(d) If the input separation factor is 2.0, then all 4 single-year values for ages 1, 2, 3, and 4 are assumed to be equal to the value for the 4-year age group, 1 to 4 years of age:

$$M_x = {}_4M_1 \quad \text{for } x = 1, 2, 3, \text{ and } 4$$

(e) When the input age-specific central death rates are for the base year, it may be desirable to obtain the same number of deaths as implied by the

abridged life table and the population in the age groups under 1 year, 1 to 4 years, and 5-year age groups 5 to 9 years and above. This can be accomplished in two ways. The first is to assume that the single-year rates are all equal to the 4-year rate for ages 1 to 4 years as indicated in (d) above. The second is to specify the *adj* option on the MX record. This will cause the program to adjust the splitting of the age-specific central death rates to obtain the same number of deaths implied by the population aged 1 to 4 years and the value of ${}_4M_1$. This is accomplished by an initial splitting of ${}_4M_1$ into M'_x values for ages 1 to 4 years as indicated above in (b) or (c). However, an input separation factor may not be reproduced as a result of the adjustment. Then the deaths based both on the single-year population values and on the 4-year age group are computed:

$${}_4D_1' = \sum_{x=1}^4 M'_x P'_x$$

$${}_4D_1 = {}_4M_1 \sum_{x=1}^4 P'_x$$

$$M_x = M'_x * \frac{{}_4D_1'}{{}_4D_1} \text{ for } x = 1, 2, 3, \text{ and } 4$$

b. Life Tables

The symbols representing the life table functions are as follows:

${}_n d_x$	Life table deaths between exact ages x and $x+n$.
e_x	Expectation of life at age x .
${}_n k_x$	Separation factor of deaths.
l_x	Life table survivors to exact age x .
${}_n L_x$	Life table stationary population in the age group x to $x+n$ years, or person-years lived between exact ages x and $x+n$ years by a birth cohort of l_0 .
${}_n m_x$	Age-specific central death rate for the population between exact ages x and $x+n$. The symbol m_z is used in the equations below to refer to the central death rate for the population age z years and over.
${}_n q_x$	Probability of dying before exact age $x+n$ given survival to exact age x .
${}_n S_x$	Life table survival ratio, or the probability of a cohort in the age group $x-n$ to x surviving n years, to the age group x to $x+n$. ${}_n S_0$ is the probability of an n -year birth cohort surviving from birth to the age group 0 to n . ${}_n S_z$ is the probability of persons aged $z-n$ years and over surviving to ages z and over, n years later.
T_x	Life table stationary population ages x and over, or the number of person-years lived in the ages x and over by a birth cohort of l_0 .

If the age group width variable (n above) is dropped, then n is assumed to be 1. For example:

$$q_0 = {}_1 q_0$$

The following equations indicate how the life table measures are computed starting from the ${}_n m_x$ values estimated based on the input mortality data.

$${}_n k_x = \begin{cases} n/2 & \text{if } x > 0 \text{ and } n=1, \text{ or } x \geq 5 \text{ and } n=5 \\ \text{user input or} & \\ \text{Coale-Demeny formula} & \text{if } x=0 \text{ and } n=1, \text{ or } x=1 \text{ and } n=4 \end{cases}$$

$${}_n q_x = \frac{{}_n m_x}{1 + (n - {}_n k_x) {}_n m_x}$$

$$l_{x+n} = l_x (1 - {}_n q_x)$$

$${}_n d_x = l_x - l_{x+n}$$

$$L_0 = l_1 + k_0 d_0$$

$${}_nL_x = {}_nk_x l_x + (1 - {}_nk_x) l_{x+n}$$

$$e_z = 1/m_z$$

where z is the initial age of the last, open-ended age group.

$$e_{80} = 3.725 + 6.25l_{80}$$

if m_z is not entered as input and $z=80$ (see note below if $z<80$ and m_z is not given).

$$T_z = l_z e_z$$

$$L_z = T_z$$

$$T_x = \sum_{i=x}^z {}_nL_x$$

If the lower bound of the last age group, z, is not equal to 80, and m_z is not provided (because q_x values were input), then the value of e_z is computed by extrapolating the ${}_nq_x$ values up to age 80, and then using the formula for e_{80} shown above. The ${}_nq_x$ values are extrapolated as follows:

$$R = \frac{{}_nq_{z-n}}{{}_nq_{z-2n}}$$

$${}_nq_{x+n} = R {}_nq_x \quad \text{for } x=z-n \text{ to } 70$$

$$l_{80} = l_z (1 - {}_nq_z) (1 - {}_nq_{z+n}) \dots (1 - {}_nq_{75})$$

5. Integrating Reported Deaths

The use of registered deaths (with or without adjustment) in making projections allows the user to incorporate new vital registration data into a projection on a timely basis. The flexibility of the death data input allows for the different types of tabulations that may be made of the data, from preliminary totals to detailed data by single years of age.

The program implements this procedure as follows:

- (1) The program makes test projections with two life tables (the most recent and the closest one that follows). When there are several years of death input, it uses the life table estimated from a prior year of death input as the most recent life table.
- (2) It then compares deaths resulting from these projections, age group by age group, to the input deaths; and a new set of ${}_n m_x$ values is estimated by interpolation.
- (3) The program then uses these interpolated m_x values to project again and compares the resulting deaths to the input.
- (4) Lastly, it proportionally adjusts the latest m_x values to obtain the input deaths.
- (5) The whole procedure is repeated until the sum of the absolute differences between the estimated and input deaths by age is less than 0.4. If this convergence is not achieved within 10 iterations, then a warning message is issued, but the program continues.

In order for the program to perform step (1) above, the user must always include mortality patterns for a time before and after the years for which death data are input. In most cases, this pattern corresponds to that of a benchmark life table that predates the death data and an ultimate life table to be used to get interpolated life tables for the projected years.

In addition, since the life table for the year with DTH record input cannot be determined until the projection gets to that year, it cannot be used to interpolate ${}_n m_x$ values for earlier years. Operationally, this means that DTH records can be for the base year (if pre-base year MX or MLT records are present) or a DTH record must be for a year immediately following a year with MX, QX, MLT, or DTH data.

6. Integrating Reported Births

The integration of actual data on births into RUP is much simpler. This is because total births can be used directly in the projection. When ASFRs are used, they are applied to the projected women to estimate births, then the births are used to project the population under age 1. When data on births are provided as input, the program skips using the ASFRs and uses the births directly.

In order to estimate the ASFRs, the program must compare input births (possibly by age of mother) to the surrounding ASFRs. There are several possible situations:

- (1) No ASFRs provided, births given by age. In this case, the program computes the ASFRs from births and female population.
- (2) One set of ASFRs provided (before or after birth data). If no births provided by age, the program multiplies the ASFRs by the female population and then proportionally adjusts the ASFRs to the reported births. If births are given by age, it adjusts the ASFRs within each of the input age groups.
- (3) At least two sets of ASFRs provided (one before and one after). In a manner similar to the way the deaths are adjusted, the program multiplies each of the ASFRs by the female population, then interpolates between the two ASFRs to match the input births (by age, if necessary).

H. Error Messages

1. Introduction

This section presents the error and warning messages you are likely to encounter when running RUP. If you get an error or warning message, look up the message in this section. Then check the inputs indicated as the probable cause of the problem and try to make the appropriate corrections. Once an error or warning is detected, the program will often generate other errors/warnings that will be fixed by correcting the first problem. Be sure to look at the input file as a whole to ensure that all desired inputs are present in the proper order. Refer to Table 2 (page 25) for guidelines on the order of parameter records.

Check all parameter records and data records to ensure that all inputs have been entered accurately and in the correct columns.

Be careful not to confuse the small letter "l" with the number one (1), nor the capital letter 'O' with the digit zero (0).

If you detect an error, look at the input listing file (this should have the same name as your input file except with the extension .OUT). This is where most of the errors/warnings will be listed.

If you cannot resolve the error, please email pop.ipc.des.web@census.gov with the following information:

1. Your name
2. Institutional Affiliation
3. Computer Operating System (Windows XP, Windows 7, etc.)
4. Version of Microsoft Office (2000, 2003, 2007, 2010, etc.)
5. Your input file (as an attachment)
6. A screenshot of the error

2. FORTRAN Run-Time Errors Displayed on the Monitor

These error messages indicate problems in trying to execute the RUP program, usually involving arithmetic or input/output devices. The cause of the problem is sometimes difficult to identify, but the best approach is to determine approximately what year the program was working on and check the inputs for that year (as well as for the years it may have been using for interpolation).

F6099 INTEGER overflow
F6100 INTEGER overflow

The program computed an integer value too large to store.

Check your input file for data in the wrong location, missing decimal points, or incorrect data.

F6101 invalid INTEGER

The program detected an illegal character when trying to read an integer value. The only characters allowed are:

space or +-0123456789

Check your input file for letters or other extraneous characters in numeric fields.

F6103 invalid REAL

The program detected an illegal character when trying to read a real value. The only characters allowed are:

space or +-.0123456789

Check your input file for letters or other extraneous characters in numeric fields.

F6104 REAL math overflow

The program computed a real number that is too large to store.

Check your input file for data in the wrong location, missing decimal points, or incorrect data.

F6422 no space left on device

You have run out of space on a device (probably a disk).

Review where your output files are being stored and check how much space is available. You may need to delete some files or send your output files to a different disk (e.g., a hard disk) or reduce the amount of output requested.

M6101 Floating point error: invalid

The program attempted to make a computation involving a storage location that does not contain a valid number.

Probable program error, please send the input file to
pop.ipc.des.web@census.gov.

M6103 divide by zero

The program tried to divide a number by zero.

Check your input data for zero (0) values, and look at what data are being used for interpolation.

M6104 overflow

The program computed a number that is too large to store.

Check your input file for data in the wrong location, missing decimal points, or incorrect data.

M6105 underflow

The program computed a number that is too small to be represented accurately.

Check your input file for data in the wrong location, missing decimal points, or incorrect data.

R6003 integer divide by 0

The program has tried to divide a number by zero.

Check your input data for zero (0) values, and look at what data are being used for interpolation.

3. RUP Errors/Warnings Displayed on the Monitor

CHECK OUTPUT LIST FILE FOR ERRORS/WARNINGS

*** NUMBER OF ERRORS/WARNINGS = xx
FOR DETAILS, CHECK OUTPUT LISTING FILE file.OUT

The program detected xx error or warning conditions while scanning your input file or performing the projection. If a serious error was detected, the following message will also be displayed:

*** AT LEAST ONE SERIOUS ERROR WAS FOUND ***

Check your output listing file for error messages or warnings.

ERROR ENCOUNTERED TRYING TO OPEN YOUR INPUT FILE
DO YOU WANT TO RE-ENTER THE FILE NAME? (Y/N)

The program could not find your input file.

Recheck the drive, path, and spelling of the filename. If you see your mistake, type "Y," press **<Enter>** and then re-enter the proper input file name when prompted. Otherwise, type "N," press **<Enter>**, then locate the input file (e.g., using the DOS DIR command).

4. Errors/Warnings Printed in the RUP Input Listing File

*** EOMQ ERROR 200 : INVALID REGION= i

The region code sent to the subroutine EOMQ was not 1, 2, 3, or 4.

Check your REG (Coale-Demeny model life table region code) input record.

*** EOMQ ERROR 240 : INVALID SEX CODE= i

The sex code sent to subroutine EOMQ was not 1, 2, or 3.

Check the sex codes on your mortality input parameter records.

*** EOMQ ERROR 280 : INVALID NUMBER OF AGES= i

The number of age groups sent to subroutine EOMQ was not valid.

Probable program error, please send the input file to pop.ipc.des.web@census.gov.

*** EOMQ ERROR 520 : s nQ x= xxxx.xxxxx MX=xxxx.xxxx

*** EOMQ ERROR 520 : QX (i)= XXXXXXXXXXXX.XXXXX

The i-th probability of dying (ngx) sent to subroutine EOMQ is invalid. Data is for males if s=M, females if s=F.

Check mortality input data.

*** EOMQ ERROR 670: UNABLE TO CLOSE LIFE TABLE BASED ON QX, TOO MANY AGES

The program encountered a ngx value for an age greater than 80.

When QX input records are used, the life table is closed using the Coale-Demeny (1966) method, which assumes the life table ends at age 80. If your open-ended age group is beyond 80+, you must use MX input.

*** EOMQ ERROR 680: EXTRAPOLATED QX VALUE FOR AGE GROUP i = XXXXXXXXXXXX.XXXXX

The program encountered nq_x input for a life table that ends before age 80. When QX input records are used, the life table is closed using the Coale-Demeny (1966) method, which assumes the life table ends at age 80. If your open-ended age group is less than 80+, the program extrapolates your nq_x values to close the life table. If you get this error, an extrapolated nq_x value is less than 0 or greater than 1.

Examine your QX input data (particularly the last two age groups) to see if there are large changes, or use MX record inputs.

*** EOMQ WARNING: QX=0 FOR GROUP # i

The program detected a zero ngx value.

If this is not expected, note the last year that has been displayed on the monitor and examine the mortality input data for the next year. The age group number i may be either single or 5-year age group.

*** GETFERT ERROR: IFR= i, NFERT= j

The program was looking for the i-th fertility input, but encountered only j fertility inputs.

Check your fertility inputs.

**** GETFERT WARNING 1410: ASFR EXTRAPOLATION:

TFR 1 = xxx.xxxx

TFR 2 = yyy.yyyy

DESIRED TFR = zzz.zzzz

You are trying to interpolate between two sets of ASFRs with TFRs of xxx.xxxx and yyy.yyyy. The value to which you are trying to interpolate, zzz.zzzz, is outside the range defined by the ASFRs you are interpolating between.

Although this may work satisfactorily, if xxx.xxxx and yyy.yyyy are close together, and/or any ASFR moves in the opposite direction from the TFR (i.e., the ASFR gets larger when the TFR gets smaller), the interpolated values can be unrealistic, including negative or extremely high values. If the TFR values are very close, simply repeat the ASFRs for the year you want to interpolate (i.e., use the same pattern) and follow that ASFR record with a TFR record containing the desired TFR value.

*** GETMIG ERROR 1025--INPUT MIGRATION DATA CANNOT

*** BE FOR BOTH SEXES

The program encountered migration inputs (MIGN, MIGR, RUMN, and RUMR records) that specify data for both sexes combined.

Estimate the migration values by sex.

*** GETMIG ERROR 9000--REQUEST MADE TO INTERPOLATE MIGRANTS TO A TOTAL BASED ON A PATTERN WITH A

*** ZERO TOTAL

One set of migrants to use in interpolation has a net migration total of zero.

Estimate net numbers of migrants for another year where the net migration is not zero, which can then be used for interpolation.

*** GETMORT ERROR: IM=i

Current mortality pointer = i.

Check your mortality inputs.

*** GETMORT ERROR: PROCESSING ENDING DUE TO PREVIOUS ERROR ***

The subroutine GETMORT could not continue due to previous errors.

There should be another error message explaining the problem.

**** GETMORT WARNING 789: LT EXTRAPOLATION

E0 1 = xx.xx

E0 2 = yy.yy

DESIRED E0 = zz.zz

You are trying to interpolate between two life tables with e_0 values of xx.xx and yy.yy. The value to which you are trying to interpolate, zz.zz, is outside the range defined by the life tables you are interpolating between.

Although this may work satisfactorily, if xx.xx and yy.yy are close together, and/or any e_0 value moves in the same direction as the e_0 (i.e., the e_0 gets larger when the e_0 gets larger), the interpolated values can be unrealistic, including negative or extremely high values.

Look carefully at the two mortality patterns you are using to interpolate. In some cases, you may need to construct a set of ${}_n m_x$ values for the year you wanted to interpolate.

*** GETMORT ERROR 930: s nM(x) VALUES USED FOR INTERPOLATION: xxxx.xxxxx xxxx.xxxxx

One or more of the values to be used for interpolation of m_x values is invalid. Check mortality inputs for the years surrounding where the error occurs.

*** GETMORT ERROR 7251: ZERO BASE MORTALITY CANNOT BE USED TO GET NON-ZERO DEATHS FOR AGE X

If the implied deaths are zero, the program cannot estimate non-zero deaths. Try combining DTH input age groups so the implied deaths will be greater.

***GETSXRB ERROR: ISX=n NSXRB=m

Requested sex ratio at birth value number n, but only m values were recorded as input.

*** INTPLT ERROR 300: s nM(x) VALUES USED FOR INTERPOLATION: 9.99999 9.99999

where s= "M" or "F" indicating which sex, n is the width of the age group (1 or 5), and x is the age group starting age.

One or more of the values to be used for interpolation of m_x values is invalid. Check mortality inputs for the years surrounding where the error occurs.

***MIGIN ERROR 160: BOTH MIGRATION RATES AND NUMBERS HAVE BEEN READ

At this time, only migration rates or net numbers of migrants can be input for each type of migrant (MIGR or MIGN inputs and RUMR or RUMN inputs).

Convert all migration inputs for each type to either rates or net numbers of migrants. The input international and internal migration data do not both need to be rates or migrants.

*** MLTMX ERROR 180: INVALID SEX CODE= i

The sex code sent to subroutine MLTMX, i, was not 1 or 2.

Check mortality inputs.

*** MLTMX ERROR 220: INVALID REGION CODE= i

The model life table region code, i, was not 1, 2, 3, or 4.

Check your REG input record.

*** MLTMX ERROR 360: INVALID SEX OR REGION FOR E0=99.0

*** NSEX=i, LSEX=j, NREG=k, LREG=l

You are using the value 99 for life expectancy when using model life tables to get the corresponding life table for the opposite sex, and the parameters do not match.

Check your MLT input. On the previous call to create a model life table, the program requested sex=j for region=l. The second call requested sex=i and region=k. In order for this procedure to work, i must not be equal to j, and k must equal l.

*** MLTMX ERROR 460: MORE THAN 10 ITERATIONS

It took more than 10 iterations to solve for the requested model life table. This should not occur.

Check your input data for mortality. This could also reflect a hardware problem in the computations.

*** MLT10 ERROR 180: E10= xx.xx, I=i ALGQX= y

The program cannot compute a model life table because it is trying to compute a number that is too large ($y \geq 170$).

*** MXMOD WARNING: MORE THAN 25 ITERATIONS

BUT E0 CONVERGED WITHIN 0.01 YEARS

The MXMOD procedure to extrapolate life tables did not converge within a tolerance of 0.001 years to your requested life expectancy after 25 iterations, but the result was within 0.01 years.

Check your mortality inputs. This indicates that you are using the alternate MXM record procedure, which involves extrapolating ${}_n m_x$ values based on Coale-Demeny model life tables. This error may result from an empirical pattern of mortality that is significantly different from the Coale-Demeny region specified on the REG record, and a different region may work better. This error can also occur at very low levels of mortality (high e_0 values). Use of the interpolation method, by including an "ultimate" life table, will eliminate this error and will usually result in more realistic patterns of mortality.

*** MXMOD ERROR: MORE THAN 25 ITERATIONS

E0= xx.xx, E0NEW= yy.yy,

CURRENT E0= zz.zzz

The MXMOD procedure did not converge to within 0.01 years of the desired e_0 value after 25 iterations.

See the notes for the previous message. Try a different region code on the REG record, or include an "ultimate" life table.

**** PROJ ERROR 1710: NEGATIVE POP. FOR AGE i

The projection estimated a negative population for the single age i .

This is usually the result of net numbers of migrants too high for the population in the age group. Check your population (POP) and migration (MIGN, MIGR, RUMN, or RUMR) inputs.

*** QM04 ERROR -- NO MO OR QO VALUE GIVEN ***

No valid infant death rate or infant mortality rate was passed to subroutine QM04.

Check your mortality input.

*** QM04 ERROR 41: INVALID SEX CODE = i

*** QM04 ERROR 41 = INVALID REGION CODE = j

The sex code, i , or the region code, j , was invalid. Valid sex codes and 1, 2, or 3, and Coale-Demeny region codes are 1, 2, 3, or 4. Check REG input record and mortality inputs.

*** QM04 ERROR 130: SEPO= xxxx.xxxx
 An invalid separation factor was passed to the QM04 subroutine.
 Check your mortality input.

*** QM04 ERROR -- NO M14 OR Q14 VALUE GIVEN ***
 No valid central death rate or mortality rate for ages 1-4 was passed to subroutine QM04.
 Check your mortality input.

*** QM04 ERROR 230: SEP1= XXXXXXXX.XXXX
 An invalid separation factor was passed to the QM04 subroutine.
 Check your mortality input.

*** QM04 ERROR 410: QX (i) = xxxx.xxxx
 The program detected an invalid ngx value of xxxx.xxxxx.
 Check your mortality input.

*** RDPAR ERROR 220: INVALID RECORD TYPE
 tttt rest of record
 The program does not recognize the record type tttt (at this location).
 Review your input file.

- If you have too many lines of data records, the program may assume one of them is a parameter record.
- The asterisk may be missing from a comment record in column 1.
- The record type tttt may not have been entered correctly or it does not start in column 1.

*** RDPAR ERROR 320: INVALID SEX CODE
 A parameter record contains a sex code other than M, F, B, E, or a blank.

*** RDPAR ERROR 500: I/O ERROR
 An I/O error has occurred while reading your input file.
 Check your input file to see if it can be read by another program (e.g., the editor you used to create it). Possible hardware error or problem disk.

*** RUPIN ERROR 10
 *** INVALID SEX CODE
 The sex code on the parameter record is invalid.
 Check the indicated parameter record, and review the valid sex codes for this type of record.

*** RUPIN ERROR 20
 *** INVALID AGE CODE
 The age code on the parameter record is invalid.
 Check the indicated parameter record, and review the valid age codes for this type of record.

*** RUPIN ERROR 30

*** INVALID YEAR

The year on the parameter record is invalid.

Check the sequence of years for this component/input type, the base year of the projection (specified on the POP record), and the final projected year (specified on the PROJ record).

*** RUPIN ERROR 40

*** INVALID NO. OF AGES

The number of ages of input is invalid.

Check the indicated parameter record, and compare the number of ages indicated to that indicated on the N or N5 record. Also check to be sure the age code is correct.

*** RUPIN ERROR 50

*** INVALID SEQUENCE OF YEARS

The sequence of years is invalid for the current parameter record.

Check to be sure all the inputs for each component (fertility, mortality, international migration, and rural/urban migration) are in chronological order.

*** RUPIN ERROR 60

*** DATA NOT FOUND FOR BOTH SEXES

The program did not find parameter records for the current input type to define the input for each sex.

Check your input file for missing input or a sex code error.

*** RUPIN ERROR 70

*** DATA WILL EXCEED STORAGE FOR THIS COMPONENT

The current parameter record provides too many data inputs (parameter records or data items) for this component.

Consider alternate ways of specifying the data (e.g., letting the program interpolate, using 5-year age group input rather than single years) to conserve space.

*** RUPIN ERROR 80

*** SUPPLEMENTARY DATA FOR SAME SEX AND YEAR MUST BE SINGLE YEARS

Supplementary single year data is misspecified.

Check the input to be sure the supplementary data:

- (1) Immediately follow the corresponding 5-year data.
- (2) Specify the same sex (or blank sex field).
- (3) Specify the same year (or blank year field).

Check the input data to see if this error message may have resulted from miscoding the sex or year field on a parameter record when supplementary single year data are not being specified.

***** RUPIN ERROR 120 : tttt PARAMETER RECORD NOT EXPECTED HERE**

The *tttt* parameter record should not be in this location in the input file.

Refer to Table 2, page 25, of the RUP documentation for the rules regarding the order of parameter records.

***** RUPIN ERROR 180 : UNIDENTIFIED PARAMETER RECORD**

ttttsayyyy rest of record

The program does not know how to process the *tttt* parameter record.

Check your input file to see if you may have misspelled the parameter record type.

***** RUPIN WARNING 220 : TITL RECORD ALREADY PROCESSED**

The program expects only one TITL parameter record. The program will ignore this record.

Remove the extra TITL record and following data records. Check to see if an AREA or TOT record is missing.

***** RUPIN ERROR 260 : NTITL MUST BE IN RANGE 0 TO 7**

The program encountered a TITL record where the number of title lines (*ntitl*) was outside the valid range of 0 to 7.

Check the TITL record to be sure the value of *ntitl* is between 0 and 7 (0 or blank default to a value of 1). Remember that the number of title records plus number of special age groups must be less than or equal to 8 ($ntitl + nspag \leq 8$).

***** RUPIN ERROR 440 : MORE THAN ONE PROJ RECORD**

The program found more than one PROJ record in the input file.

Remove one of these records.

***** RUPIN ERROR 500 : INVALID YEAR ON PROJ RECORD**

The final projection year is before the base year of the projection.

Change either the base year (on the POP record) or the projected year (on the PROJ record).

***** RUPIN ERROR 580 : MORE THAN ONE N5 OR N RECORD**

The program encountered more than one N or N5 record.

Remove one of the records.

***** RUPIN ERROR 620 : N5 MUST BE IN RANGE 11 TO 21**

The value of *n5* (number of 5-year age groups) on the N5 record is less than 11 or greater than 21.

Enter a valid value for *n5*.

***** RUPIN ERROR 700 : N MUST BE IN RANGE 51 TO 101**

The value of *n* (number of single years of age) on the N record is less than 51 or greater than 101.

Enter a valid value for *n*.

*** RUPIN ERROR 740 : N MUST BE 1 + (MULTIPLE OF 5)

The program found an invalid value of *n* on the N parameter record. The value of *n* (number of single years of age) must be one more than a multiple of 5 (e.g., 76, 81, 86, ... 101).

Enter a valid value for *n*.

*** RUPIN WARNING 880 : SXRB OUTSIDE RANGE OF 0.9 TO 1.2

The sex ratio at birth is outside the expected range. The ratio should be male births per female birth (NOT per 100 female births).

Check to make sure the value for the sex ratio at birth is correct.

*** RUPIN ERROR 940 : MORE THAN ONE REG RECORD FOR THIS AREA

The program found a REG record has already been processed for this area.

Delete one REG record or check to see if an AREA or TOT record is missing.

*** RUPIN ERROR 980 : REG VALUE MUST BE 1, 2, 3, OR 4

The region code, *reg*, on the REG record must have a value of:

- 1 = West
- 2 = North
- 3 = East
- 4 = South

Check your input file to make sure the *reg* code is correct and in the proper column (20) of the REG record.

*** RUPIN ERROR 1040 : MORE THAN ONE SPAG RECORD

The program found a SPAG record has already been processed for this area.

Delete one SPAG record or check to see if an AREA or TOT record is missing.

*** RUPIN ERROR 1080 : NSPAG MUST BE IN THE RANGE 1 TO 7

The number of special age groups, *nspag*, on the SPAG record is less than 1 or greater than 7.

Check your input to be sure you have entered the correct number in column 20 of the SPAG record.

*** RUPIN ERROR 1180 : INVALID VALUE FOR SPECIAL AGE GROUP *i* : *j* - *k*

The *i*-th special age group, specified as *j* to *k*, is invalid. This results when:

- k* is less than *j*, or
- j* is less than 0

Check your input to be sure your age group has been entered correctly in the proper columns.

*** RUPIN ERROR 1340 : AREA= *i*, PHASE= *j*
 The program was processing area *i* during phase *j*.
 Probable program error, please send the input file to
pop.ipc.des.web@census.gov.

*** RUPIN ERROR 1480 : NO TITLE RECORDS
 The program could not find the TITL record input.
 Check your input file to be sure this is included with the associated
 data records containing the title for the run.

*** RUPIN ERROR 1520 : NO N OR N5 RECORD
 The program could not find the N or N5 record input.
 Check your input file to be sure one of these records is included.

*** RUPIN WARNING 1585 : NUMBER OF TITLE RECORDS PLUS NUMBER OF SPECIAL AGE GROUPS MUST BE 8 OR LESS
 The program found that the number of title records (following the TITL
 record) plus the number of special age groups (specified on the SPAG
 record) was more than 8.
 Check both records to see what was specified. Remember that there are
 several standard special age groups, so limit your SPAG input to only
 those additional groups that are needed.

*** RUPIN ERROR 1600 : NO PROJ RECORD
 The program could not find the PROJ record input.
 Check your input file to be sure it is included.

*** RUPIN ERROR 1760 : NO POP RECORD FOR area name
 The program could not find a population input (POP record).
 Check your input file to make sure it includes the POP records with the
 base population data.

*** RUPIN ERROR 1800 : NO MX, QX, OR MLT RECORDS FOR area name
 The program could not find mortality data by age for the current area.
 Check your mortality input to be sure it includes at least one MX, QX,
 or MLT record. Remember that DTH input requires patterns of mortality
 for a prior and following year.

*** RUPIN ERROR 1821 : NO MX, QX, OR MLT AFTER DTH
 The program could not find mortality data by age for the current area
 after DTH record input.
 Check your mortality input to be sure it includes at least one MX, QX,
 or MLT record after the DTH record. Remember that DTH input requires
 patterns of mortality for a prior and following year.

*** RUPIN ERROR 1840 : NO ASFR RECORD FOR area name
 No age-specific fertility data were input for the current area.
 Check your fertility input to include at least one ASFR record.

***** RUPIN ERROR 1880 : NO MIGRATION DATA BY AGE FOR area name**

International migration input (MIGN records) was given for at least one year, but no data by age were specified.

Check your migration input to be sure there are migration data by age for at least one year.

***** RUPIN ERROR 1920 : NO INTERNAL MIGRATION BY AGE FOR area name**

Internal migration input (RUMN records) was given for at least one year, but no data by age were specified.

Check your migration input to be sure there are migration data by age for at least one year.

***** RUPIN WARNING 1930 : NO INTERNAL MIGRATION DATA FOR area name**

The program could not detect any internal migration data for this area, which was not designated as the total.

This is a warning only, and in many cases the assumption of no internal migration may be acceptable.

***** RUPIN WARNING 1960 : NO REG RECORD FOR area name**

***** WEST REGION WILL BE USED IF NECESSARY**

The program could not find a REG record in the input file, but the program will use the west model region where needed.

If you wish to use a different Coale-Demeny region, include a REG record with the desired region code in column 20.

***** RUPIN ERROR 2000 : NO SXRБ RECORD FOR area name**

The program could not find the SXRБ record input.

Check your input file to be sure it is included.

***** RUPIN ERROR 2012 : INCONSISTENT MORTALITY DATA BY SEX**

IMA:

YRMA:

MTYPE:

MAGEA:

MLOCA:

The input mortality data recorded by the program contain inconsistencies by sex (in terms of amount of data, age grouping, type of input, or years of input).

Check your mortality input for each year to be sure that the same type and age groupings of data are specified.

***** RUPIN ERROR 2200 : MULTIPLE POP RECORDS FOR area name**

The program has read more than one set of POP records for the given area name.

Check to see if an AREA or TOT record is missing and one of the sets of POP records belongs to another area.

***** RUPIN ERROR 2660 : NOT ENOUGH POPULATION DATA**

Not enough age groups of population data (single years) were specified compared to the N or N5 record.

Check columns 11-20 of the POP record to ensure the correct number of age groups was specified.

***** RUPIN ERROR 3000 : NOT ENOUGH POPULATION DATA**

Not enough age groups of population data (5-year age groups) were specified compared to the N or N5 record.

Check columns 11-20 of the POP record to ensure the correct number of age groups was specified.

***** RUPIN ERROR 3100 : NEGATIVE POPULATION FOR AGE i = XXXXXXXXXXXX.**

The population for age *i* is negative.

Check the POP records for errors in input data or the location of the data in the records. This error can occur when the BEERS split of the 5-year age groups into single years results in a negative population. If this is the case, you should examine the input data carefully to be sure there are no errors or to determine whether the negative value is the result of age-misreporting that should be smoothed before projecting. If you find the data acceptable, enter data by single years of age.

***** RUPIN ERROR 3220 : CONFLICTING BASE YEARS: yyyy VS. zzzz**

POP records contain different base years (some have *yyyy*; others have *zzzz*).

Correct the input to ensure all POP records have the same year specified.

***** RUPIN ERROR 3280 : EXPECTING SUPPLEMENTARY SINGLE-YEAR DATA**

Data on the current POP record have the same year but not the opposite sex code from the previous POP record. This indicates that the current data should be supplementary single year age data. However, the sex code is not the same or the data are not by single years as expected.

Check the POP records.

***** RUPIN ERROR 3500 : INVALID SEP0 VALUE**

The input separation factor for infant deaths is outside the range $0.02 \leq \text{SEP0} \leq 0.5$ and, therefore, is considered invalid.

Check the mortality input to be sure the separation factor has been coded in the correct columns and that the decimal point is located correctly.

***** RUPIN ERROR 3540 : INVALID SEP1 VALUE**

The input separation factor for ages 1 to 4 years is outside the range $0.5 \leq \text{SEP1} \leq 2.0$ and is considered invalid.

Check the mortality input to be sure the separation factor has been coded in the correct columns and that the decimal point is located correctly.

***** RUPIN ERROR 4360 : ADJ OPTION CAN ONLY BE SPECIFIED FOR BASE YEAR**

The program found the adj option in column 50 of the MX record, which can only be specified for the base year (the year on the POP record).

Check the MX records to be sure the adj option is only specified for the base year.

***** RUPIN ERROR 4390 : ADJ OPTION NOT POSSIBLE WITH QX INPUT**

The program found a non-zero value for adj specified on a QX record.

Check the QX input in question and either (a) substitute an MX record and associated data records, with the adj option included, or (b) remove the non-zero adj value from the QX record.

***** RUPIN WARNING 4450 : MX = 0**

LOCATION = i SEX CODE = j

The program found an n_{m_x} value equal to zero.

The program will try to continue, but this may cause further problems.

***** RUPIN ERROR 4460 : INVALID MX VALUE = XXXXXXXXXX.XXXXX**

LOCATION = i, SEX CODE = j

The program found an n_{m_x} value greater than 1.0 or less than 0.0.

Check your mortality input data. Location *i* indicates where the data are located in the storage array. The sex code *j* has the value 1 if male, and 2 if female.

***** RUPIN ERROR 6180 : INITIAL AGE OF 5-YEAR ASFRS MUST BE 10 OR 15**

The program found the lower bound of the first 5-year age group of ASFRs (specified in columns 19-20) was neither 10 nor 15.

Check your input ASFR records.

***** RUPIN ERROR 6260 : INITIAL AGE OF SINGLE-YEAR ASFRS MUST BE IN RANGE 10 TO 19**

The program found the lower bound of the first single-year age group of ASFRs (specified in columns 19-20) was less than 10 or greater than 19.

Check your input ASFR records.

***** RUPIN ERROR 6360 : INVALID ASFR VALUE = XXXXXXXXXX.XXXXX**

An ASFR value is less than 0 or greater than 0.75.

Check the data records following the ASFR record.

***** RUPIN ERROR 6440 : INVALID TFR VALUE**

The program detected a TFR value less than 0 or greater than 15.

Check all the input TFR values making sure they are entered in the proper columns and with the decimal point correctly specified.

***** RUPIN ERROR 6500 : INVALID YEAR FOR TFR OR PRIOR DATA NOT ASFR**

The year on a TFR input record is invalid (e.g., it precedes the prior fertility input) or it is the same year as the previous fertility input which was not ASFR data.

Check your fertility inputs to be sure you do not have more than one TFR record for any year, and that all fertility inputs are in chronological order.

*** RUPIN ERROR 6640 : RUMN OR RUMR RECORDS NOT EXPECTED HERE

RUMN or RUMR records were found in the TOT section of a projection.

Check the location of all TOT, AREA, RUMN, and RUMR records.

*** RUPIN ERROR 7060 : DSRN CONFLICT

*** DSRN CANNOT EQUAL ii

The *dsrn* field on an output specification record contains a preassigned value.

Check the list of preassigned data-set reference numbers in Table 4, page 65, and choose a number not on that list.

*** RUPIN ERROR 7280 : INVALID CODE VALUE

*** CODE VALUES MUST BE IN THE RANGE 0 TO 999999

The code for an area contained on a CODE record is negative or greater than 999999.

Check the CODE record to be sure the *arnum* field (columns 11-20) contains the area code number in the correct location (i.e., it ends in column 20).

*** RUPIN ERROR 7403 -- NO LIFE TABLE BEFORE DTH RECORDS

The program found a DTH record without at least one life table for a year prior to the death data and for at least one year after the death data. These life tables can be entered using MX, QX, or MLT records.

Check the mortality input records.

*** RUPIN ERROR 7407 -- NO LIFE TABLE FOR YEAR PRIOR TO DTH DATA

The program found a DTH record without life table input for the year prior to the death data and for at least one year after the death data. These life tables can be entered using MX, QX, or MLT records or another DTH record if there is an MX, QX, or MLT record before all DTH records.

Check the mortality input records.

***RUPRO ERROR 2025: year s AGE x POP=xxxxxxxxxxxxxx

The population for age x is negative (see value given). Check net migration numbers to be sure you are not having too many people emigrating.

*** RUPRO ERROR 9011 : IM=ii NMORT = jj

IFR = kk NFERT = ll

IMG = mm NMIG = nn

IRUM = oo NRUM = pp

An error has occurred in the projection phase: the index pointer for one of the components exceeds the number of inputs for that component.

Check your component inputs (mortality, fertility, and migration).

*** RUPRO ERROR 9061 : PROCESSING ENDING DUE TO PREVIOUS ERROR

The projection cannot continue due to previous errors.

There should be another error message explaining the problem.

**** RUPTOT WARNING 205 : NEGATIVE POP FOR AGE i

In phase 3 of a projection (aggregation of two areas or computation of a residual), the program detected a negative population for age *i*. This usually happens when you are computing a residual area and the two areas projected (total and one subarea) are not consistent.

Examine the output to determine which component (mortality, fertility, or migration) seems to be responsible for the problem and correct it.

**** RUPTOT WARNING 215 : NEGATIVE DTHS FOR AGE i

In phase 3 of a projection (computation of a residual), a negative number of deaths was estimated for age *i*. This usually happens when you are computing a residual area and the two areas projected (total and one subarea) are not consistent; the mortality for the subarea implies more deaths than occurred in the total.

Change your mortality assumptions (patterns of mortality and/or levels of life expectancy).

**** RUPTOT WARNING 2070 : NEGATIVE BTHS FOR AGE i

In phase 3 of a projection (computation of a residual), a negative number of births was estimated for age *i*. This usually happens when you are computing a residual area and the two areas projected (total and one subarea) are not consistent; the fertility for the subarea implies more births than occurred in the total.

Change your fertility assumptions (patterns of fertility and/or levels of TFR).

*** RUPTOT ERROR 9061 : PROCESSING ENDING DUE TO PREVIOUS ERRORS, MAXIMUM ERROR CODE= i

The projection cannot continue due to previous errors.

There should be another error message explaining the problem.

*** WARNING -- CONVERGENCE TO DTHS NOT REACHED

The program could not reproduce the deaths input from the DTH records.

Review the two surrounding life tables for consistency of patterns by age and the death inputs for accuracy.

WARNING: PARAMETER RECORD DETECTED BEFORE EXPECTED END OF DATA

While reading in data records following a BTH or DTH parameter record, the program detected another parameter record before the expected end of the death data.

Check the number of age groups specified on the BTH or DTH record, and be sure it agrees with the number of age groups of data in the input file.

Addendum A

RUPEX Documentation


1. Introduction


The Rural and Urban Projection (RUP) program is a computer program for population projection using the cohort-component model. Although originally designed to allow projections of urban and rural areas of a country, it can also be used to project individual areas (e.g., geographic subareas, ethnic subpopulations, or populations of varying citizenship). For more information about RUP, refer to other sections in this volume, or visit:

<http://www.census.gov/population/international/software/rup/>

The RUP Excel interface system (RUPEX) is a series of Excel workbooks that can be used with the RUP program to perform cohort-component population projections. These spreadsheets and associated programs make it easier to create or modify RUP input files, run RUP projections, and extract projection output data. Currently, RUPEX works with RUP runs of a single area at a time, as opposed to RUP runs that would produce urban and rural areas in the same file.

2. Overview of RUPEX

To use RUPEX, open Microsoft Excel and click on the RUP button  on the Add-Ins toolbar. This will use your default version of RUPEX as a template to access and interact with RUP. When RUPEX is open you can select a new input file, edit the current input file, run the current projection, view the latest listing file, or extract data from the current projection. Since the RUPEX file is loaded as a template, it will show up as RUPEX1 in the title bar. If you make any changes to the file (such as opening a new RUP input file) you will be asked if you want to save changes to RUPEX1. In most cases this is not necessary since all input files created and run will be saved automatically.

The RupFormat button  on the Add-Ins toolbar can be used to convert data in Excel workbooks into RUP format. To use it, simply highlight the data you wish to convert in an Excel workbook, press the button, then select the RUP parameter type, sex code, age code, enter the year, and press the OK button. This will automatically import the data to a Notepad window in RUP format. These data can then be copied to your RUP input file. Note that the data need to be extracted separately for each sex.

3. Using RUPEX

3.1 The RUPEX Control Sheet

The RUPEX template Control sheet is shown in Figure A1.

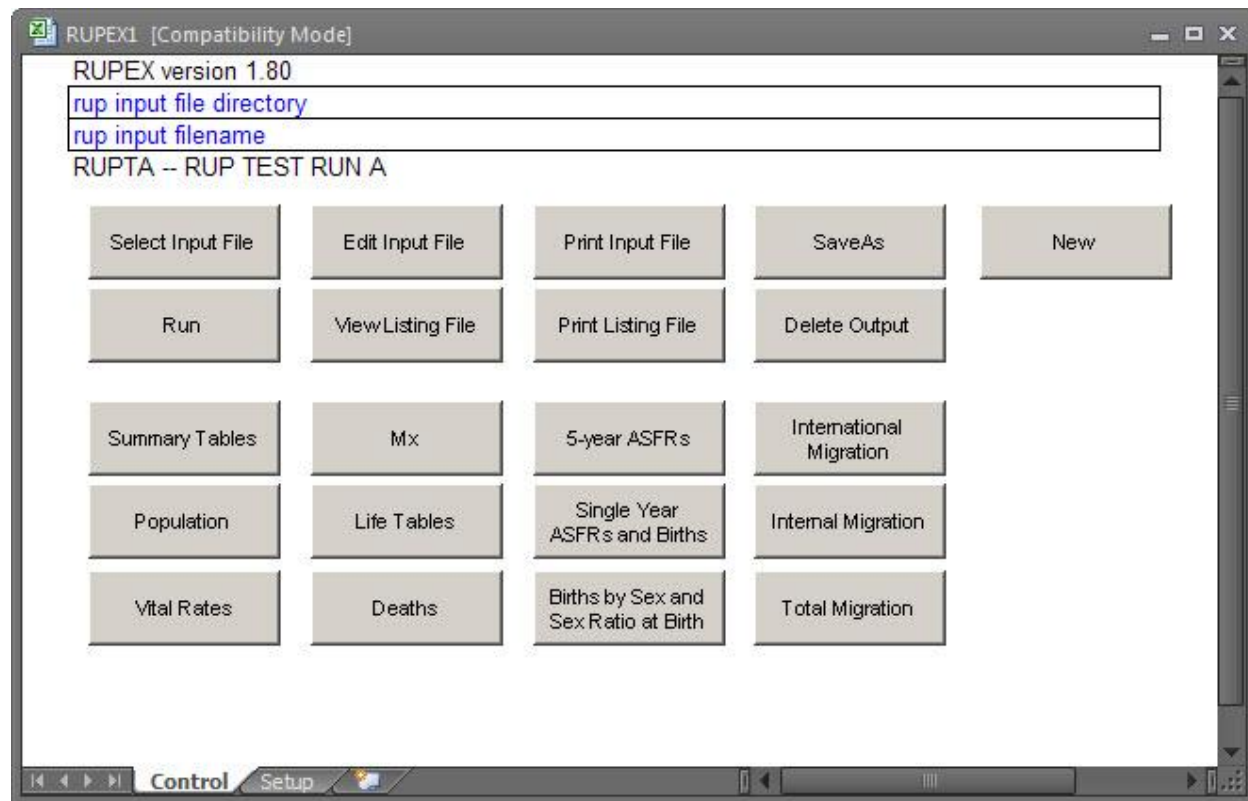


Figure A1: RUPEX "Control" Sheet

To retrieve a RUP, RUPAGG, or RUPCombine file, enter the desired input file directory and name in cells B2 and B3, respectively.² If you specify the directory, then the file will be retrieved from that location. If you do not specify the directory, then the program will look in the current Excel directory. Additionally, if the directory and filename are entered together in cell B3, the program will automatically split the directory from the filename and allocate them to their respective cells. The filename and directory can be entered manually or will be filled in automatically if you select the file using the Select Input File button.

3.1.1 Running a Projection

Select Input File. Pressing this button allows you to navigate to an existing RUP input file. Once you have located the file, highlight it and press "Open." At this point cells B2-B4 will automatically update to reflect the selected file and directory, and the first RUP TITL record. Note that if you

² In Excel, B2 is also a range named "RUPInputPath," while B3 is a range named "RUPInputFileName." Cell B4, or "RupTitle," displays the title in the selected input file.

use this button to select the file it will change the default Excel directory.

Edit Input File. Pressing this button will open the default text editor (usually Notepad.exe) and load the input file indicated in cells B2 and B3. If you make any changes to the RUP input file make sure that you save the file in the text editor program. Note that the editor window can be closed after saving the file. It can be reopened by pressing the Edit Input File button again. If the editor window is left open, you can go back to Excel, run the projection, extract data, and then return to the editor window to make further changes. To change the text editor used, make changes on the "Setup" sheet (see Figure A2).

Print Input File. Pressing this button will print the current RUP input file on the default Excel printer.

SaveAs. Pressing this button will copy the file identified in cells B2 and B3 to a user-navigated destination. The default filename will remain the same, but can be changed in the "SaveAs" dialogue box. Once the file has been copied, cells B2 and B3 will point to the new filename and/or location. This feature is useful when making changes to an existing RUP input file (e.g., updating a projection with new data or creating multiple projection scenarios).

Delete Output. Pressing this button deletes all of the output files of a projection. This includes the intermediate (.IO1) and text output (.OUT) files.

New. Pressing this button creates a new RUP input file in the default Excel directory. A form will open up allowing you to specify some information to help you create the input file.

Desired RUP input filename: Enter the filename you want to use. Note that RUP input filenames must be 7 characters or less to run properly (e.g., "Country.IN" will work but "CountryA.IN" will not).

Title for RUP run: Enter a title for the run.

Open-ended age: Specify the start of the open-ended age group.

Default age grouping: Indicate whether you want calculations done based on 5-year or 1-year data.

Base year: Enter the starting year of the projection. This is the year for which the population data must be entered.

Projected year: Enter the last year of the projection.

Sex ratio at birth: Enter the value of the sex ratio at birth. Note that if you think it will change during the projection period you can add additional SXRБ records for specific years.

Press the "Create RUP file" button when you are finished filling out the form. This will open the RUP input file in your text editor. You must then fill in the base population figures, mortality, fertility, and migration data

as needed.

Run. This button will run RUP (if the input file extension is .IN), RUPAGG (if the file extension is .AGG), or RUPCombine (if the file extension is .CMB). A Command Prompt window will open, and you will see the progress of the projection. When the projection is finished, a message will appear at the bottom of the window stating "Press any key to continue." If there are any errors or warning messages between the last year of the projection and the "Press any key" message, there may be potential problems with the projection. In this case, click the "View Listing File" button. Close the Command Prompt window once results have been evaluated.

View Listing File. If there was an error or warning identified when the projection was run (or if there were other issues), press this button to review the detailed error and warning messages or to determine how far the interpretation of the input file progressed before an error occurred. This option uses the "Text viewer" specified on the "Setup" sheet (see Figure A2). Most error and warning messages for RUP are described in section H of this document. Most messages will be found in the listing file, but certain types will only show up in the Command Prompt window.

Print Listing File. If there are many errors or an error is difficult to locate, printing the listing file may allow a closer examination of the output to help pinpoint the problem.

3.1.2 Extracting Projection Output

Summary Tables. This option will load the RUPST.XLS workbook that extracts the data from RUP Summary Tables 1 and 2. Summary Table 1 includes the following measures for each year: total population, growth rate, crude birth rate, total births, crude death rate, total deaths, and net migration numbers and rates (both international and internal). Summary Table 2 includes life expectancies at birth and infant mortality rates by sex, and total fertility rate for each year of the projection. In addition to extracting the data into spreadsheet form, this spreadsheet includes graphs of the measures.

Population. This option will load the RUPPOP.XLS workbook and extract population data from the intermediate file of the current RUP projection. Note that the CODE record must be present in the RUP input file in order for the intermediate file to be created. The population data are extracted by sex and single years of age and are presented in a population pyramid on sheet "Pyramid." The population by sex, 5-year age groups, and special age groups as well as summary measures may be obtained in tabular format on sheet "Select."

Vital Rates. This option will load the RUPVR.XLS workbook and extract the vital rates output data. This is similar to the data in the summary tables, but also includes some details by sex as well as births and fertility rates by age of mother. These data are extracted from the full-page output generated when the OUTF record is included in the RUP input file.

Mx. This option extracts the sex and age-specific central death rates from the life table output of the RUP projection using RUPMX.XLS. The graph on sheet "AgeCht" allows the plotting of selected years or a dynamic plot over a selected series of years. The graph on sheet "TimeSer" allows you to plot the

changes over time in mortality in selected age groups. These data are extracted from the full-page output generated when the OMX record is included in the RUP input file.

Life Tables. This option loads the RUPLT.XLS workbook as a template and allows you to extract life table output data. Data for selected years and males and/or females can be extracted. The extracted life tables are stored in separate sheets of the workbook with names in the form "syyyy" where s = "M" for male or "F" for Female and yyyy = year. These data are extracted from the full-page output generated when the OMX record is included in the RUP input file. If the output life tables are complete life tables, then the RUPLT template will also compute the corresponding abridged life table (with sheet name "syyyyA").

Deaths. This option loads the RUPDTH.XLS workbook and extracts death data from the intermediate files of the current RUP projection. Note that the CODE record must be present in the RUP input file in order for the intermediate file to be created. The death data are extracted by sex and single years of age and are presented in a pyramid on sheet "Pyramid."

5-year ASFRs. This option loads the RUPASFR.xls workbook and extracts only the age-specific fertility rates (ASFRs) from the vital rates output. The ASFR data can then be viewed in the graph on sheet "FIGS." The graph allows the plotting of selected years or a dynamic plot over a selected series of years. The "TimeSer" sheet allows you to graph ASFRs for one or more age groups over time.

Single Year ASFRs and Births. This option loads the RUPBTH.XLS workbook. The output includes: births by single-years of age of the mother, ASFRs by single ages, female population by single years of age, and a graph allowing the plotting of the single-year ASFRs for selected years.

Births by Sex and Sex Ratio at Birth. This option loads the RUPSXRB.XLS template. This extracts the data on births by sex and computes the sex ratio at birth.

International Migration, Internal Migration, and Total Migration. These options all load the RUPMGN.XLS workbook and extract international, internal, or total net migration data by sex and single years of age. These data are extracted from the intermediate file of the current RUP projection. Note that the CODE record must be present in the RUP input file in order for the intermediate file to be created. The "AgeCht" sheet allows you to view one or more years of migration data on one graph or as a dynamic graph. The "Select" sheet allows you to extract migration data in 5-year age groups and special age groups.

3.2 The RUPEX Setup Sheet

The RUPEX template Setup sheet is shown in Figure A2.

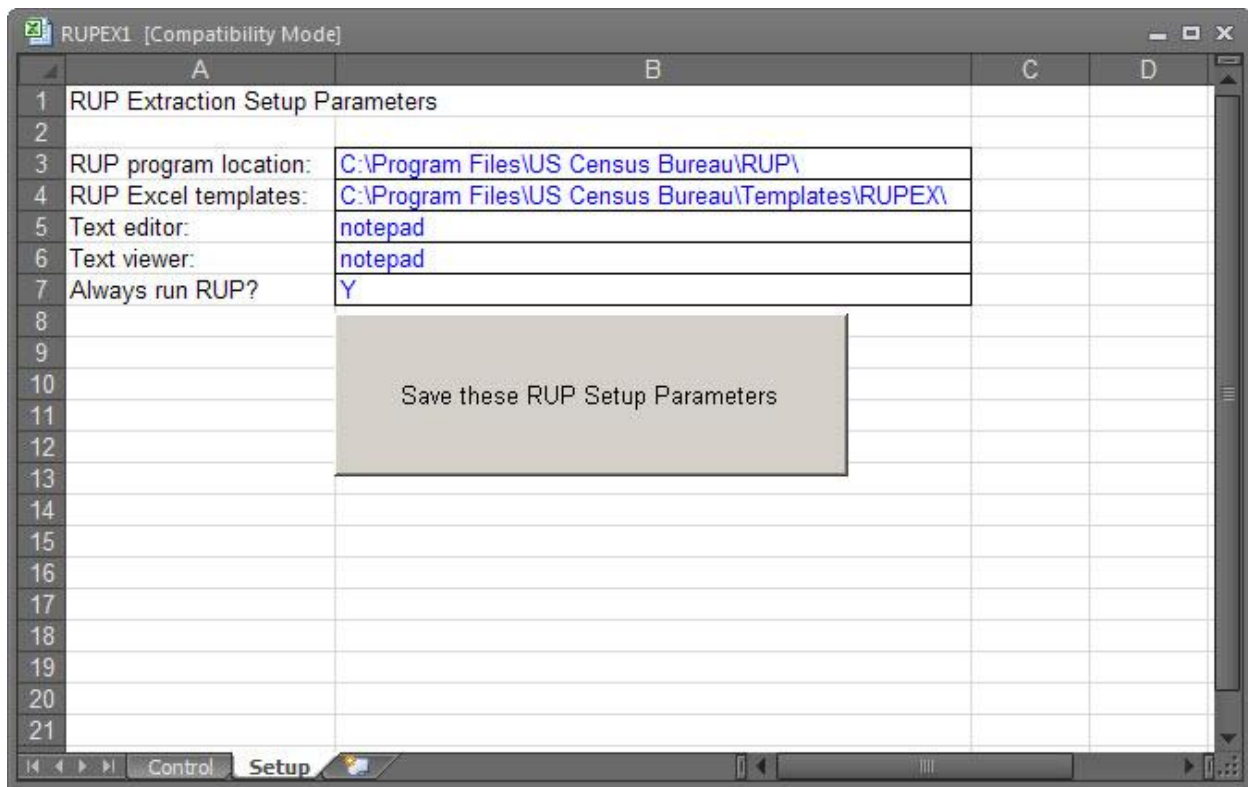


Figure A2: RUPEX "Setup" Sheet

RUP Program Location. Cell B3 denotes the file directory location on your system where RUP, RUPAGG, RUPCombine, and RUPEX are located.

RUP Excel templates. Cell B4 denotes the file directory location on your system where the RUPEX output templates (RUPST.XLS, RUPPOP.XLS, RUPVR.XLS, etc.) are located.

Text editor and Text viewer. Cells B5 and B6 denote the text editor and viewer program(s) for editing and viewing RUP input, RUPAGG, and RUPCombine files. By default, the program assigns Windows Notepad to these cells.

Always run RUP? Cell B7 is a Yes/No query. Before running a file, RUPEX will look for an associated output file. If you mark "N" in this cell, then RUPEX will prompt with a question asking if you would like to replace the output. If you mark "Y" in this cell, then you will not be prompted with a question. By default, this cell is marked with "Y" and the question will not appear.

Save these RUP Setup Parameters. The contents of cells B3-B7 are automatically generated upon installation and can be altered if the programs are moved to a different location, if a new text editor or viewer is chosen, or if you wish to be prompted before replacing RUP output files. If any changes have been made to the contents of cells B3-B7, press this button to

save the changes. The settings will be imported instantly to the registry and will reappear the next time you open RUPEX. It is not necessary to save RUPEX.XLS to preserve these changes.

Addendum B
RUPAGG Documentation

1. Introduction

The RUPAGG program creates population projections by adding and/or subtracting between two and 300 separate projections produced by the RUP program. The program adds and/or subtracts integral numbers of population, births, deaths, and net numbers of migrants from different areas to arrive at a total or a residual regional projection. These population values must be stored in intermediate files by the RUP runs. This is accomplished by including CODE records in the RUP runs (see page 36 in this volume). RUPAGG files, denoted by the file extension .AGG, are distinguished from RUP input files, which use the file extension .IN.

2. General Structure of Input to RUPAGG

The input to RUPAGG consists of two types of records (just like RUP): parameter records and data records. The parameter records can serve three functions:

- (1) describe certain aspects of the projection (e.g., the TOT record indicates that the records that follow apply to the total area projection),
- (2) define parameters of the projection (e.g., the PROJ record indicates the final year of the projection), or
- (3) introduce certain data records.

The parameter records all follow the same fixed format as RUP. The parameter records that are recognized by the program are shown in Table B1.

The data records contain the data of a repetitive nature, and allow for formats specific to the information they contain (e.g., character data for the title records and 5-column fields of numeric data for the special age groups). The formats of the data records are identical to the same records in RUP. The format for the records in RUPAGG that are not part of RUP are shown in section 2.1.2 to 2.1.4.

Table B1. RUPAGG Parameter Records and Their Functions

Type	Description
TITL	Precedes records with descriptive information to be printed on each page of output.
N5	Specifies the number of 5-year age groups to be used in the aggregation.
N	Specifies the number of single years of age to be used in the aggregation.
SPAG	Specifies the special age groups for which population data are to be printed.
PROJ	Specifies the final year of the projection.
AREA	Names the aggregated area.
CODE	Specifies a code number to be associated with the aggregated area and creates an intermediate file with the aggregated data.
TOT	Indicates the area name is "T O T A L".
BASE	Indicates desired base year of aggregation.
INPF	Indicates the code number of each area and the name of the intermediate file where the data are stored.
RUM	Indicates internal migration data are present.
OUTP	Controls full-page output.
OPOP	Controls special population output.
OMX	Controls age-sex-specific central death rate output.
ODTH	Controls output of deaths by age and sex.
OBTH	Controls output of births by age of mother.
END	Indicates the end of the projection inputs.
NOTE	Allows the inclusion of descriptive notes that are printed only as encountered during input.
*	Alternate note format.
EDIT	Allows scanning of parameter and data records without projecting.

2.1 Parameter Records

2.1.1 Parameter Record Rules

The parameter records and any associated data records DO NOT need to follow certain rules regarding where they are located in the input to RUPAGG.

Only one Required: TITL, [N5, N], PROJ, [AREA, TOT], BASE

One or more required: INPF

Optional: EDIT, SPAG, CODE, OUTP, OMX, OPOP, ODTH, OBTH, END, RUM

Notes:

[A, B] Choose only one parameter record, A or B.

The NOTE parameter record and associated notes or the * format of the notes can be placed at any location in the run where a parameter record is expected.

2.1.2 The BASE Record: Initial Projection Year

The BASE record is used to indicate the beginning year (*ybeg*) of the projection. One BASE record with a *ybeg* value greater than or equal to 0 is required for each run. The *ybeg* value must be greater than or equal to the beginning year of each of the projections being aggregated (but the individual projections do not need to begin with the same year).

```
*-----
*      10      20      30      40      50      60
*-----|-----|-----|-----|-----|-----|-----
BASE ybeg
*-----
```

Record	Columns	Field	Definition
1	1-4	BASE	Indicates this is a <u>BASE</u> record.
	7-10	<i>ybeg</i>	Beginning year of the projection.

Example: Specify the beginning year of the aggregation.

```
*-----
*      10      20      30      40      50      60
*-----|-----|-----|-----|-----|-----|-----
BASE 1995
*-----
```

The populations should be aggregated starting in 1995.

2.1.3 The INPF Record: Area Reference Number for Input Intermediate Files

The INPF record specifies the area reference number to help identify the data and the data record that follows contains the name of intermediate file.

```
*-----
*      10      20      30      40      50      60
*-----|-----|-----|-----|-----|-----|-----
INPF      arnum
filename
*-----
```

Record	Columns	Field	Definition
1	1-4	INPF	Indicates this is a <u>INPF</u> record.
	5-14	blank	
	15-20	<i>arnum</i>	Area reference number. This number must be right-justified. A negative number indicates that this area should be subtracted from the aggregation.
2	1-80	<i>filename</i>	Name of the intermediate file with the data corresponding to area <i>arnum</i> . If no path or drive is specified, the default drive is assumed.

Example 1: Aggregate urban and rural areas

```

*-----
*          10          20          30          40          50          60
*-----|-----|-----|-----|-----|-----|-----
TOT
INFP                1
URBAN.IO1
INFP                2
RURAL.IO1
*-----

```

The first area, urban, denoted area 1, and the second area, rural, denoted area 2, are to be aggregated. Based on the intermediate file names, assuming the default naming conventions, we can conclude that the urban data were generated by an input file called URBAN.IN and the rural input file was RURAL.IN. If both intermediate files were created in one RUP run, called for example RUP.IN, then the first intermediate file created would be named RUP.IO1 and the second would be called RUP.IO2.

Example 2: Compute rural as a residual

```

*-----
*          10          20          30          40          50          60
*-----|-----|-----|-----|-----|-----|-----
TOT
INFP                1
TOTAL.IO1
INFP               -2
URBAN.IO1
*-----

```

The first area is the total, denoted area 1, while the second area, urban, is denoted area 2 and will be subtracted from the total. Based on the intermediate file names, assuming the default naming conventions, we can conclude that the urban data were generated by an input file called URBAN.IN and the total input file was TOTAL.IN.

2.1.4 The RUM Record: Internal Migration is Present

The RUM record is used to indicate that one or more of the intermediate files contain internal migration data. If this record is not present, the program will ignore internal migration data stored in the intermediate files.

```

*-----
*          10          20          30          40          50          60
*-----|-----|-----|-----|-----|-----|-----
RUM
*-----

```

Record	Columns	Field	Definition
1	1-4	RUM	Indicates this is a <u>RUM</u> record.

Example: Indicate presence of internal migration data

```

*-----
*          10          20          30          40          50          60
*-----|-----|-----|-----|-----|-----|-----
RUM
*-----

```

The populations being aggregated contain internal migration.

3. Sample input file

```
*-----
*          10          20          30          40          50          60
*-----|-----|-----|-----|-----|-----|-----
TITL                      1
AGGAB: Aggregation of RUPTA and RUPTB
BASE  1990
PROJ  1995
N5                      17
TOT
CODE                      1
*****
INPF                      1
RUPTA.IO1
*****
INPF                      1
RUPTB.IO1
*****
*****
OUTP                      1
OMX
END
```

Notes:

1. If no drive path is entered in the file name record (following the INPF record), the program will look for the file on the default drive/path.

2. The number of areas that can be aggregated is limited to 300 (depending on the individual computer configuration). To aggregate more areas, include a CODE record in the RUPAGG input file to indicate you want the program to create an intermediate file of the aggregation. This intermediate file can then be used in another aggregation run.

Addendum C

RUPCombine Documentation

1. Introduction

The programs RUP and RUPAGG project population and demographic events (births, deaths, and net migration) from midyear to midyear, but both programs will distribute estimated events evenly across full calendar years. For example, 100 deaths would be distributed so that 50 would fall in the first half of the year (January - June) and 50 would fall in the second half of the year (July - December), in a western calendar. Regardless of the mortality input type used to generate the deaths (e.g., MX, DTH, or MXM), RUP distributes them evenly across the calendar year.

However, if a cataclysmic event (e.g., an earthquake, flood, genocide, war, or famine) and associated demographic shock (e.g., extraordinary numbers of deaths or massive population movements) occurs in only one half of a year, the standard assumption of even distribution used by RUP and RUPAGG is not appropriate. RUPCombine is designed for modeling these situations.

2. Modeling Substantial Demographic Shocks with RUPCombine

RUPCombine allows the analyst to force the impact of a cataclysmic event into the half-year in which it occurred. The end result is the correct midyear population for the year in which the demographic shock takes place. For example, if there were excess deaths due to a storm in the first half of the year, the midyear population would be smaller than if the excess deaths were evenly distributed over the whole year. Alternatively, if there were excess deaths due to a storm in the second half of a year, the midyear population would remain the same as if no event had happened; if deaths were evenly distributed over the entire year, then the midyear population would be lower.

In order to capture an uneven distribution of demographic events across a calendar year, two RUP input (.IN) files can be combined using RUPCombine. For example, if 100 deaths occurred during one calendar year, but 40 deaths took place from January through June while 60 deaths took place from July through December, one .IN file containing January - June deaths should be combined with another .IN file containing July - December deaths. This process will allow for accurate mortality allocation and estimation of the midyear population.

In this example, the first .in file starts in the base year of the projection period and ends in the year of the demographic shock. The second .in file starts in the year of the demographic shock and ends in the final year of the projection period. The base population for the second file is the projected age-sex distribution from the first file, regardless of whether or not the shock takes place in the first or second half of the year.

3. RUPCombine Step-by-Step

Modeling demographic shocks with RUPCombine involves six steps:

- (1) Determine the half-year in which the demographic shock took place and estimate the expected, or "normal," level (of mortality, fertility,

and/or migration), by age and sex, for the shock year. In the case of deaths, determine the number of deaths that would have taken place had no shock occurred.

- (2) Continuing with the example of excess mortality associated with a cataclysmic event, select an estimate of excess deaths (from governmental or multinational agency reports, non-governmental reports, news articles, surveys, or other sources) and distribute those deaths across ages and sexes. If no reliable information is available on the age-sex distribution of the deaths, distribute them according to the population age-sex structure.

Normal deaths for the calendar year are then added to *twice* the number of excess deaths. The excess events need to be doubled, otherwise half of them will be deleted in the RUPCombine process.

- (3) Create a RUP input file that begins in the base year of the projection and terminates in the target year (the year of the demographic shock). If the cataclysmic event took place in the first half of the year, the mortality including excess deaths will be placed in this .IN file and the population projected to midyear of the target year must be extracted for the second RUP input file.

If the cataclysmic event took place in the second half of the year, this first .IN file will contain a normal mortality distribution. Mortality can be specified in terms of age-specific central death rates or as numbers of deaths. Mortality including excess deaths will be placed in the second .IN file.

Run the first .IN file.

- (4) Create the second RUP input file (which covers the period from the target year to the end of the projection horizon), using the projected midyear population for the target year as the base population, and specifying mortality as described in step (3). Run the second .IN file.
- (5) Develop a RUPCombine (.CMB) file to combine the two .IN files and a RUPAGG (.AGG) file to enable viewing of the RUPCombine results.

A chain of two .IN files will require one .CMB file and one .AGG file. A chain of three .IN files (for an area with several cataclysmic events in various years) will require two .CMB files but only one .AGG file.

- (6) Check the RUPAGG output against the initial estimated numbers of normal and excess events to ensure that projected events for the year preceding the target year, for the target year itself, and for the year following the target year match assumptions.

Table C1 lists the steps needed to prepare RUP, RUPCombine, and RUPAGG files to allocate excess deaths in the first or second half of a year in more detail. Illustration C1 shows a RUP input file with no excess mortality. Mortality for years 1990 and 2000 are specified in terms of age-specific central death rates (${}_n m_x$ values by age and sex). Subsequent figures and illustrations depict the modification of this simple assumption.

Table C1. RUPCombine Steps				
(When excess deaths occur in first half of target year 1995)				
Step	Input file	Description	RUPEX Button	Years
1.1	RUPA.IN	Run RUP assuming no excess deaths.	Run	1990-2000
1.2	RUPA.IN	Extract MX for the target year (the year with excess deaths) and the prior year.	MX or Life Tables	1994 and 1995
1.3	RUPA.IN	Extract deaths by age and sex for the target year.	Deaths	1995
2.1	In an Excel workbook	To create excess deaths for input into RUP, estimate normal deaths (from step 1.3) plus twice the number of excess deaths for the target year.		1995
3.1	RUPB.IN	Create a RUP input file that begins in the base year of the projection period and terminates in the target year.	Select RUPA.IN. SaveAs RUPB.IN. Edit Input File RUPB.IN.	1990-1995
3.2	RUPB.IN	Input MX data for the year prior to the target year (step 1.2) into the input file.	Edit Input File	1994
3.3	RUPB.IN	Input DTH data (including twice the number of excess deaths) for the target year from step 2.1.	Edit Input File	1995
3.4	RUPB.IN	Run RUP to midyear of target year.	Run	1990-1995
3.5	RUPB.IN	Extract population by single years of age for the target year.	Population	1995
4.1	RUPC.IN	Create a RUP input file that begins in the target year and terminates in the final year of the projection period.	Select RUPA.IN. SaveAs RUPC.IN. Edit Input File RUPC.IN.	1995-2000
4.2	RUPC.IN	Input base population extracted from RUPB.IN (step 3.3).	Edit Input File	1995
4.3	RUPC.IN	Input "normal" MX data for the target year from RUPA.IN (step 1.2).	Edit Input File	1995
4.4	RUPC.IN	Run RUP from target year to the end of the projection period.	Run	1995-2000
5.1	RUPD.CMB	Create a RUPCombine file to combine RUPB.IN and RUPC.IN.	Edit Input File	1990-2000
5.2	RUPD.CMB	Run RUPCombine to combine RUPB.IN and RUPC.IN and place excess deaths in first half of target year.	Run	1990-2000
5.3	RUPD.AGG	Create a RUPAGG file to generate a combined output created by RUPD.CMB. Use the same filename as in step 5.1, but use the file extension .AGG to create the RUPAGG file.	Edit Input File	1990-2000
5.4	RUPD.AGG	Run RUPAGG to read and interpret the .IO1 intermediate file generated by RUPCombine in step 5.2 and access the combined output.	Run	1990-2000

Table C2. RUPCombine Steps				
(When excess deaths occur in second half of target year 1995)				
Step	Input file	Description	RUPEX Button	Years
1.1	RUPA.IN	Run RUP assuming no excess deaths.	Run	1990-2000
1.2	RUPA.IN	Extract MX for the year prior to and the year after the target year (the year with excess deaths).	MX or Life Tables	1994 and 1996
1.3	RUPA.IN	Extract deaths by age and sex for the target year.	Deaths	1995
2.1	In an Excel workbook	To create excess deaths for input into RUP, estimate normal deaths (from step 1.3) plus twice the number of excess deaths for the target year.		1995
3.1	RUPB.IN	Create a RUP input file that begins in the base year of the projection period and terminates in the target year.	Select RUPA.IN. SaveAs RUPB.IN. Edit Input File RUPB.IN.	1990-1995
3.2	RUPB.IN	Run RUP to midyear of target year.	Run	1990-1995
3.3	RUPB.IN	Extract population by single years of age for the target year.	Population	1995
4.1	RUPC.IN	Create a RUP input file that begins in the target year and terminates in the final year of the projection period.	Select RUPA.IN. SaveAs RUPC.IN. Edit Input File RUPC.IN.	1995-2000
4.2	RUPC.IN	Input base population extracted from RUPB.IN (step 3.3).	Edit Input File	1995
4.3	RUPC.IN	Input MX data for the year prior to the target year (step 1.2) into the input file to set the mortality pattern.	Edit Input File	1994
4.4	RUPC.IN	Input DTH data (including twice the number of excess deaths) for the target year from step 2.1.	Edit Input File	1995
4.5	RUPC.IN	Input MX data for the year after the target year (step 1.2) into the input file.	Edit Input File	1996
4.6	RUPC.IN	Run RUP from target year to the end of the projection period.	Run	1995-2000
5.1	RUPD.CMB	Create a RUPCombine file to combine RUPB.IN and RUPC.IN.	Edit Input File	1990-2000
5.2	RUPD.CMB	Run RUPCombine to combine RUPB.IN and RUPC.IN and place excess deaths in first half of target year.	Run	1990-2000
5.3	RUPD.AGG	Create a RUPAGG file to generate a combined output created by RUPD.CMB. Use the same filename as in step 5.1, but use the file extension .AGG to create the RUPAGG file.	Edit Input File	1990-2000
5.4	RUPD.AGG	Run RUPAGG to read and interpret the .IO1 intermediate file generated by RUPCombine in step 5.2 and access the combined output.	Run	1990-2000

The following five illustrations are an example of the RUPCombine procedure, as depicted in Table C1. Illustration C1 depicts a standard RUP projection as if no cataclysmic event had occurred.

Illustration C1: RUP input file RUPA.IN with no excess mortality

TITL 1 REPUBLIC OF DEMOGRAPHICA: 1990-2000 (No Excess Deaths) N5 17 PROJ 2000 SXRB 1.05 REG 1 TOT CODE 1 *****								General information about the projection
POP M51990 21393 106353 105353 100476 87898 71875 58685 48130 39163 31573 25292 20289 15955 12052 8570 5533 3028 1766 POP F51990 20464 101648 100670 96055 84113 69172 56929 46966 38398 31109 25123 20423 16384 12745 9399 6348 3693 2450 *****								Population data
MX M51990 0.05491 0.00541 0.00150 0.00104 0.00260 0.00413 0.00387 0.00398 0.00479 0.00645 0.00895 0.01247 0.01832 0.02872 0.04300 0.06875 0.10548 0.18952 MX F51990 0.05025 0.00576 0.00121 0.00084 0.00178 0.00224 0.00230 0.00281 0.00371 0.00491 0.00641 0.00918 0.01322 0.02185 0.03475 0.05701 0.08916 0.16716 MX M52000 0.04064 0.00350 0.00106 0.00078 0.00209 0.00333 0.00310 0.00320 0.00391 0.00536 0.00763 0.01079 0.01607 0.02538 0.03806 0.06112 0.09418 0.17508 MX F52000 0.03655 0.00361 0.00079 0.00057 0.00129 0.00163 0.00166 0.00208 0.00285 0.00393 0.00531 0.00770 0.01117 0.01841 0.02935 0.04828 0.07584 0.14970 *****								Mortality data
ASFR 51990 0.07700 0.15990 0.19480 0.16480 0.11030 0.06530 0.02790 ASFR 52000 0.01870 0.07560 0.12800 0.10500 0.04740 0.01980 0.00540 *****								Fertility data
OUTP 1 OMX 1 ***** END								Output control

Illustration C2 shows the placement in a RUP input file of excess deaths in the first half of a year where a cataclysmic event occurred. This file also contains the same base population as Illustration C1 and is projected to the target year. Illustration C3 shows the resumption of normal mortality (after the cataclysmic event) in the second half of the target year. It contains a base population extracted from the preceding input file, and its projection period is from the target year to the end of the projection horizon.

TITL	1							
REPUBLIC OF DEMOGRAPHICA: 1990-1995 (Excess deaths in first half of 1995)								
N5	17							
PROJ	1995							General information about the projection
SXRB	1.05							
REG	1							
TOT								
CODE	1							

POP M51990	21393							Population data
106353	105353	100476	87898	71875	58685	48130	39163	
31573	25292	20289	15955	12052	8570	5533	3028	
1766								
POP F51990	20464							
101648	100670	96055	84113	69172	56929	46966	38398	
31109	25123	20423	16384	12745	9399	6348	3693	
2450								

MX M51990								Mortality data
0.05491	0.00541	0.00150	0.00104	0.00260	0.00413	0.00387	0.00398	
0.00479	0.00645	0.00895	0.01247	0.01832	0.02872	0.04300	0.06875	
0.10548	0.18952							
MX F51990								
0.05025	0.00576	0.00121	0.00084	0.00178	0.00224	0.00230	0.00281	
0.00371	0.00491	0.00641	0.00918	0.01322	0.02185	0.03475	0.05701	
0.08916	0.16716							
MX M51994								Life table for year prior (extracted from Illustration C1) to target year with excess deaths
0.04868	0.00454	0.00131	0.00093	0.00238	0.00379	0.00354	0.00365	
0.00442	0.00599	0.00840	0.01177	0.01738	0.02733	0.04095	0.06559	
0.10081	0.18361							
MX F51994								
0.04424	0.00478	0.00102	0.00072	0.00156	0.00197	0.00202	0.00249	
0.00334	0.00449	0.00594	0.00856	0.01236	0.02040	0.03248	0.05334	
0.08357	0.15994							
DTH E 1995								Excess deaths, equal to normal deaths plus two times the number of excess deaths for the target year
0	1	1396	1253					
1	4	2337	2249					
5	5	2722	2574					
10	5	2684	2547					
15	5	2696	2507					
20	5	2461	2219					
25	5	1988	1826					
30	5	1630	1528					
35	5	1370	1294					
40	5	1166	1095					
45	5	1004	925					
50	5	872	802					
55	5	790	713					
60	5	737	675					
65	5	663	632					
70	5	587	585					
75	5	455	482					
80	999	458	573					
MX M52000								Placeholder life table for interpolation purposes
0.04064	0.00350	0.00106	0.00078	0.00209	0.00333	0.00310	0.00320	
.	.	.						Remainder is the same as Illustration C1.

Illustration C3: RUP input file RUPC.IN with resumption of normal mortality

TITL 1 REPUBLIC OF DEMOGRAPHICA: 1995-2000 (Midyear 1995 onward w/o excess mortality) N1 81 PROJ 2000 SXR 1.05 REG 1 TOT CODE 1 *****								General information about the projection
POP M11995 19114 19130 19763 20120 20393 20487 20608 20717 20781 20820 20824 20787 20719 20620 20484 20330 20099 19779 19350 18841 18290 17729 17126 16486 15821 15146 14493 13879 13320 12814 12317 11822 11355 10911 10487 10082 9687 9304 8927 8560 8201 7858 7523 7197 6884 6580 6286 6002 5727 5466 5211 4965 4735 4514 4309 4108 3909 3718 3529 3350 3168 2985 2813 2639 2476 2311 2154 1999 1852 1711 1565 1426 1291 1161 1045 928 814 714 621 535 2191 POP F11995 18269 18282 18888 19232 19488 19594 19692 19811 19874 19916 19928 19888 19822 19727 19596 19458 19249 18958 18561 18081 17570 17049 16492 15904 15296 14670 14051 13471 12946 12468 12000 11540 11093 10668 10265 9877 9498 9131 8768 8416 8073 7745 7422 7113 6813 6521 6242 5971 5714 5466 5223 4991 4769 4561 4368 4180 3999 3822 3647 3478 3310 3140 2974 2813 2658 2503 2348 2198 2053 1911 1770 1628 1489 1361 1233 1112 994 883 776 684 3088 *****								Population data
MX M51995 0.04724 0.00435 0.00126 0.00090 0.00233 0.00371 0.00346 0.00357 0.00433 0.00588 0.00826 0.01160 0.01716 0.02700 0.04045 0.06482 0.09967 0.18216 MX F51995 0.04286 0.00456 0.00098 0.00069 0.00152 0.00191 0.00195 0.00242 0.00325 0.00439 0.00583 0.00841 0.01215 0.02006 0.03194 0.05246 0.08223 0.15819 MX M52000 0.04064 0.00350 0.00106 0.00078 0.00209 0.00333 0.00310 0.00320 0.00391 0.00536 0.00763 0.01079 0.01607 0.02538 0.03806 0.06112 0.09418 0.17508 MX F52000 0.03655 0.00361 0.00079 0.00057 0.00129 0.00163 0.00166 0.00208 0.00285 0.00393 0.00531 0.00770 0.01117 0.01841 0.02935 0.04828 0.07584 0.14970 *****								Normal mortality data for target year and mortality data for a later year
ASFR 51990 0.07700 0.15990 0.19480 0.16480 0.11030 0.06530 0.02790 ASFR 52000 0.01870 0.07560 0.12800 0.10500 0.04740 0.01980 0.00540 *****								Fertility data
OUTP 1990 OMX 1990 ***** END								Output control

Illustrations C4 shows the RUPCombine (.CMB) file used to combine the two RUP files – one reflecting normal mortality, and the other, excess mortality. Illustration C5 shows the RUPAGG (.AGG) file constructed to allow review and extraction of the results of the RUPCombine process.

Illustration C4: RUPCombine file, RUPD.CMB

TITL 1 REPUBLIC OF DEMOGRAPHICA: 1990-2000 (Excess Mortality Combine File) RUPD.CMB ***** BASE 1990 PROJ 2000 CODE 1 ***** * 1990-95 INPF 1 RUPB.IO1 ***** * 1995-2000 INPF 1 RUPC.IO1 ***** END	General information about the projection
	File with first portion of projection
	File with second portion of projection
	Output control

Illustration C5: RUPAGG file, RUPD.AGG

TITL 1 REPUBLIC OF DEMOGRAPHICA: 1990-2000 (Excess Mortality AGG File) RUPD.AGG ***** * RUN TO AGGREGATE RESULTS FROM RUP COMBINE * The AGG file should have the same name as the CMB file ***** BASE 1990 PROJ 2000 N 81 AREA National CODE 1 ***** RUM ***** OUTP 1 2000 OMX 1 2000 ***** END	General information about the projection
	Code to include RUM migration
	Output control

Figures C1, C2 and C3 illustrate the impacts modeling excess deaths with RUPCombine has on projected population, deaths, and life expectancy at birth, respectively.

In Figure C1, population is projected to grow from just under 1.6 million persons in 1994 to nearly 1.74 million persons in 2000 in the absence of the demographic shock (blue line). If excess deaths were incorporated into a RUP input file for 1995 without using RUPCombine, the deaths would be evenly distributed throughout the entire calendar year. Population would continue to grow but would attain a value about 200,000 persons less in 2000 because of the population loss in 1995 (green line). If excess deaths occurred in the first half of 1995, then the projected 1995 midyear population would not adequately reflect the timing of those deaths. The estimated midyear-to-midyear growth from 1994 to 1995 would be too rapid, and the estimated midyear 1995 population would be too large.

The RUPCombine series in Figure C1 (red line) shows the impact of excess deaths occurring in the first half of 1995 and the correct placement of those deaths using RUPCombine—reduced population growth for 1995 and a smaller projected midyear population in that year than in either other scenario.

Figure C2 shows that the number of deaths occurring in calendar year 1995 is the same regardless of whether they are allocated evenly or forced into one half of the year. In either case, an extra 20,000 deaths are assumed to take place in 1995.

Figure C3 shows the impact of incorporating the effect of the demographic shock on life expectancy at birth for 1995. Life expectancy drops by over 20 years between 1994 and 1995 then recovers in 1996. Again, the allocation of deaths does not affect the composite life expectancy at birth for the year in which the cataclysmic event occurs.

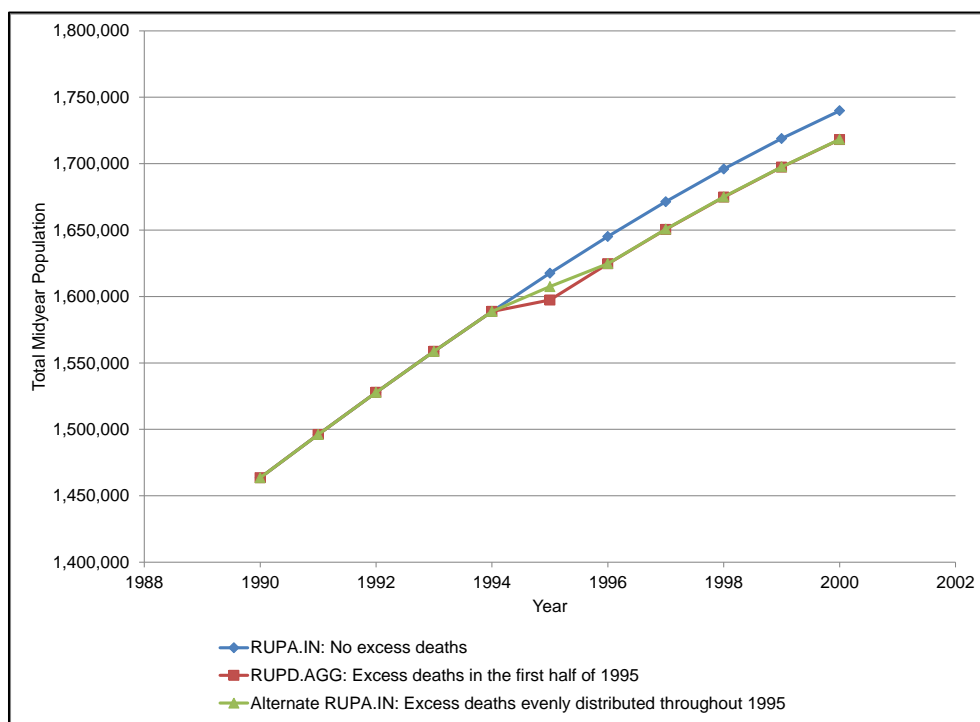


Figure C1. Total Midyear Population, With and Without RUPCombine

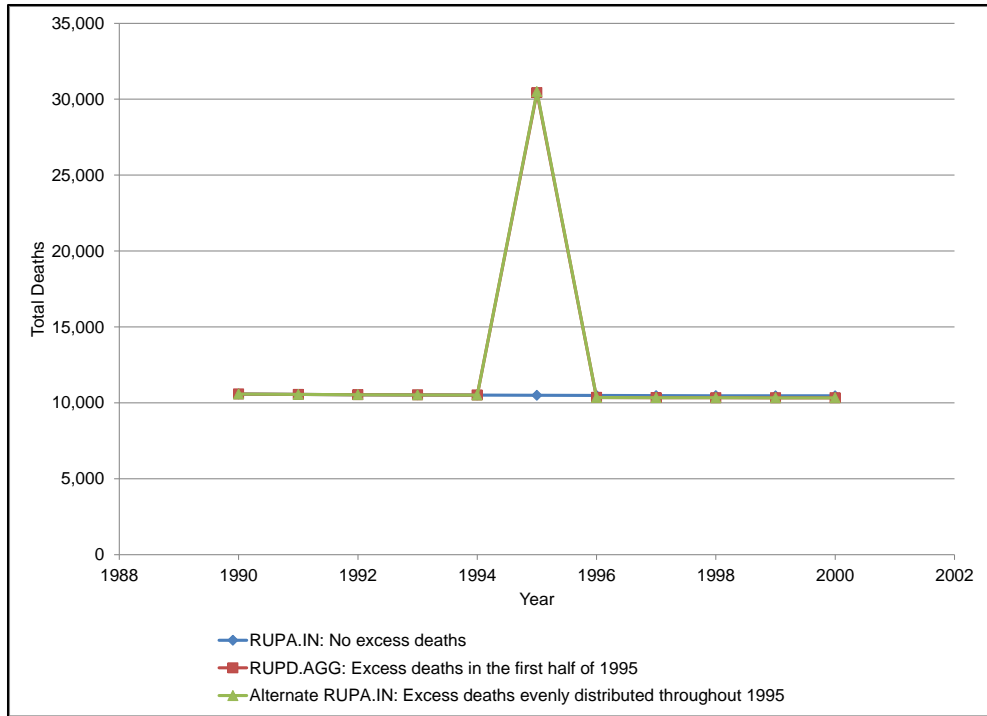


Figure C2. Total Deaths, With and Without RUPCombine

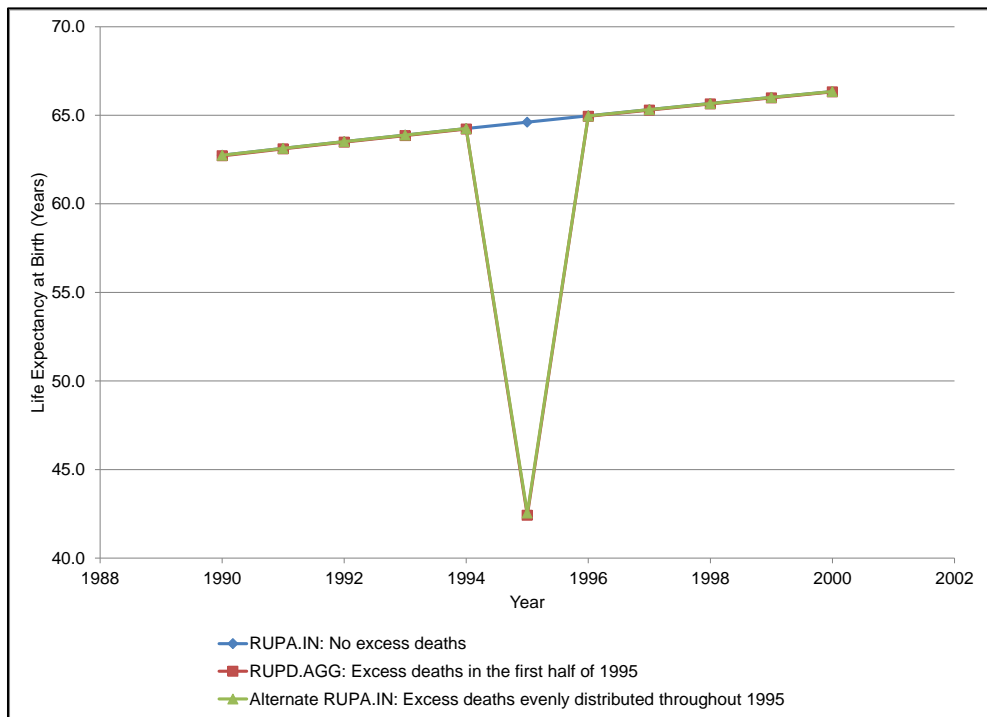


Figure C3. Life Expectancy at Birth, With and Without RUPCombine